INDUSTRIAL GROWTH, REGIONAL STRUCTURE AND DIFFERENTIALS IN JAPAN

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I. *Causes of Regional Differentials and Their Remedies*

The postwar rapid economic growth, particularly the 1955-61 boom, has brought forth various problems in the national economy, such as the widening of regional differentials in incomes and productivities, the excessive concentration of population toward big cities, the distorted accumulation of productive capacity in the particular industrial districts, the shortage of industrial water and consequent sinking of the ground, the emergence of smog in big cities, and the aggravated traffic congestion, in conjunction with the rise of consumer prices amounting to 6-8% per annum from around 1959. Consequently, the problem of the regional economy as well as the development of less developed areas has attracted an increasing attention of the public. This was really an unprecedented phenomenon never experienced before the war. Although the development of less developed areas (e. g. Hokkaidō) before 1950 aimed mostly at an increase in production of foods or the development of natural resources, this emphasis has gradually shifted toward different objectives after the Korean war. For instance, although the Plan for the Industrial Belt along the Pacific Ocean in the Income-Doubling Plan still strongly preserved an intention to promote the rational location of factories, it also emphasized a new target, namely, the elimination of excessive concentration. Thus, as the economic growth proceeded rapidly, different kinds of targets have come to be more seriously considered, such as the elimination of regional productivity or income differentials and of the public nuisances accompanied by the excessive expansion of cities, the enhancement of the welfare of local inhabitants, etc. The enforcement of various acts, such as the Act for Accelerating the Development of Industries in Local Undeveloped Areas of 1961, the Act for the Nationwide Comprehensive Development and the Act for Accelerating the Construction of New Industrial Cities in 1962, stands for the fact that the importance of the strategic development of local key points and the urgency with which the nationwide systematic plan should be established have been recognized.

Such a consciousness for this problem did not arise before the war. Of coure, we had some policies for the destitute condition of the Tōhoku region before the war or the Kokudo Keikaku (the national land planning) mostly for military purposes during the war, but the importance of regional problems in the economy as a whole was never so generally recognized as in the postwar period. In 1961, the per capita income of Tōkyō was ¥274,692 but that of Kagoshima Prefecture was ¥78,316 (28.5% of Tōkyō). In addition to the existence of such a wide gap in prefectural incomes, it is generally held that the regional discrepancy

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of the prefectural incomes has tended to expand owing to the "high-pitched growth". Whether this is true or not should be tested carefully, but even if it is not so, we cannot deny that the regional income differential is already tremendously aggravated.

In this analysis, we shall focus our analysis on the regional income or productivity differentials, and the regional differences of industrial structure, which is generally supposed to be attendant upon the high-pitched growth and heavy industrialization in the recent period.

Be that as it may, the regional differential, in terms of per capita income or productivity, has an aspect which indicates that its disappearance is relatively unlikely or difficult to happen, differing from inter-industry or inter-scale differential. If there occurs a phenomenal increase in physical productivity in some industry, we shall have an adjustment process whereby the relative price of its commodity will decline so as to interrupt the rise of the relative wages in that industry. However, even if physical productivity increases fantastically in one region, it may be quite unlikely that prices of commodities in that region become permanently cheaper, because, in such an economy in which the transportation has been highly developed, the same price tends to prevail as to the same commodity. Therefore, it is impossible for us to have changes in the regional price structure in inverse proportion to changes in the regional physical productivity. If the cheaper commodities permeate in other regions and excel competitive commodities, the decline of relative per capita income in other regions seems to be inevitable. In this sense, the regional differential of physical productivity will not be absorbed in the regional price structure and is likely to result in the regional differences of wages and per capita incomes. This is the fundamental reason why the regional differential is more apt to be aggravated than the inter-industry or inter-scale counterparts.

It is true that the regional differential of incomes will be reduced if we have sufficiently flexible mobility of labor. However, in this case, one may have instead an excessive migration of labor to big cities, in addition to which are the overcrowded traffic, the shortage of residences in conjunction with the increasing land price, and other public nuisances.

Moreover, the location of industry has a common attribute of regional concentration, particularly if various types of "combinations" are set up, and different factories are combined with each other by the pipes or other means in a particular region. Such an inherent tendency toward regional concentration surrounding particular industrial regions will also manifest a rather cumulative trend, in accordance with the rapid progress of heavy industrialization. And this is not restricted to the petro-chemical industry alone. In the neighborhood of big automobile factories too, such as Toyota or Nissan, we have an innumerable number of parts makers getting together. In these big automobile factories, they adopt the so-called "supermarket system", according to which the parts produced by a lot of parts makers flow in each stage of the production process without time lag. In order for this system to work effectively, it is of course necessary for parts makers to locate themselves very closely to the big factories. Thus, the so-called "industrial estate" sometimes may be built up inevitably.

The industrial development will inevitably have a regional specialization, taking into account of the closeness of the product market, the distance to the raw material supplying area, the supply of labor force, the existence or non-existence of complementary industries, the supply of industrial water, etc.

If so, the concentration of investment to the particular industrial districts will bring about a strong regional concentration of industrial capacity and play a role of enlarging productivity differentials among prefectures. But since this will not be absorbed in the regional price

structure, the per capita income differential will be necessarily widened. The migration of population which tends to equalize the differential will stimulate, on the one hand, the population concentration to big cities and make inevitable the occurrence of public nuisances. If we intend to evade the excessive concentration, then the regional differential of per capita incomes cannot but be accelerated. The speedier the tempo of the industrial development is, the more we are destined to be annoyed with this dilemma. The fact that the adjustment by regional price structure and regional migration of labor force is thus decidedly limited will be an ultimate cause explaining the inevitable occurrence of regional differentials.

If so, the objective of removing the regional differentials cannot be achieved only by the acceleration of regional mobility of labor force. By pushing forth a comprehensive systematic plan for the development of local undeveloped areas, focussing particularly on the strategic development of local key points, the need for public investment on the social-overhead capital and for the decentralization of the location of industries has begun to be recognized. However, on the one hand, the pursuit of business-profit motive (private rational behavior) will necessarily entail the regional concentration. On the other hand, the objective to decentralize industries goes along the social rationality. Thus, there is an urgent need for the present to harmonize the private and social rationalities and to set up a long-term, comprehensive regional plan, in order to minimize the problems thus far explained. In view of the above, a social-overhead investment on the construction of roads, harbors, rivers, etc., even in areas where no factories will intend to locate themselves, is hoped for, under the consistent and effective regional plan to build up new industrial districts in under-developed areas.

II. *Is the Regional Differential Aggravated?*

It is a generally accepted view that since the regional income or productivity differential has been widened between advanced and less advanced areas, the policies to eliminate such differentials are urgently necessary. It is true that we have a wide dispersion of per capita incomes and productivities among regions, but is it equally true and also acceptable a view that these differentials have been widened in the postwar economic development? Let us start examining it statistically. There may be several statistical methods to be used to estimate the degree of the regional differential. One may simply examine the difference of two extremes, the highest and the lowest, but since we have 46 prefectures, this is very unsatisfactory. Hence, we have preferred to use here a rather simple statistical technique, the computation of the coefficient of variation (the standard deviation divided by the mean value). If we would like to know some indicator on the degree of absolute dispersion among 46 prefectures as concerns the variable X, then the standard deviation will be derived by using the formula, $\sqrt{\sum(X-M)^2/N}$, where M is the simple average of X's in 46 prefectures, and N is the number of prefectures.

If we take up M_w, the average of X's weighted by the population of each prefecture, instead of M, then we must use the following formula,

$$\sqrt{\frac{\sum_1^{46} f(X-M_w)^2}{\sum_1^{46} f}}$$

where f stands for the weight of population in each prefecture.

However, in this formula, we may encounter the following problem. Since there may be a migration of population from low-income prefectures to high-income ones, figures for f's

may change yearly, and the weighted average of X's ($=M_w$) can change only due to the population migration among prefectures, even when there were no change in each value of X's. This is illustrated by a simple example. Let us assume that in Japan we have only two prefectures, α and β, and that the per capita incomes were unchanged from last year to this year, and that α is higher than β in the per capita income level. If we have a population movement from β to α in this case, the weighted average of prefectural per capita incomes M_w cannot but rise to some extent, even when per capita incomes in α and β are invariant. The relative income of α and β, compared with M_w, will both decline in this case, despite the constancy of incomes in the two prefectures.

This strange result can be evaded, if we use a "fixed" weight every year instead of the "variable" weight, e.g., the weight of 1955 population in each prefecture. In this case, even if there were any migration among prefectures, the weighted average of incomes would be constant, in so far as the per capita incomes in α and β are invariable. Denoting as f_{55}, the fixed weight, given by the population in 1955 in each prefecture, and as $M_{\bar{w}}$, the consequent weighted average, we will find that the standard deviation will then be,

$$\sqrt{\frac{\sum f_{55}(X-M_{\bar{w}})^2}{\sum f_{55}}}$$

In looking for an indicator of regional differentials, it is necessary that we use the "fixed" weight instead of the "variable" weight. The simplest standard deviation based on the simple average $\sqrt{\sum(X-M)^2/N}$ is a special case of the "fixed" weight standard deviation in which each prefecture is given the same weight. We shall therefore use the standard deviations, based on the simple average M as well as the weighted average $M_{\bar{w}}$ with 1955 populations as the fixed weight.

In Table 1, we have computed the standard deviation and the coefficient of variation of per capita incomes as well as the value-added per employee (further broken down into heavy and light industries) among 46 prefectures. Since the standard deviation (an indicator of the absolute differential) increased hand in hand with an increase of the average per capita income for 1955–61, the coefficient of variation, — the ratio of the two, will present us an indicator of the relative regional differential.

As Table 1 and Fig. 1 indicate, the coefficient of variation of prefectural per capita incomes indicates cyclical changes in accordance with the actual business cycle, except for an abnormally high coefficient of 1950. From these indicators, it is noticed that we cannot observe any clear evidence of the widening tendency of regional income differential. Although a slight upward tendency (except for 1950) can be discernible, it is expected that from 1962 on the coefficient of variation would have declined owing to the cessation of the rapidly increasing tempo of fixed investment. Therefore, it is safe to assume that there is no upward tendency of regional income differential from 1951 onward.

However, one may be skeptical of the reliability of the prefectural income statistics. Therefore, we have computed the coefficient of variation also in relation to the value-added per employee in heavy and light industries as well as manufacturing industry, as based on the Census of Manufactures. We have three observations: 1) There are no increasing tendency in the coefficient of variation for this period. 2) The year-to-year fluctuations of the coefficient of variation are very irregular. 3) The most noteworthy is the fact that, although the coefficient of variation as concerns manufacturing as a whole almost levels off, the coefficients for heavy and light industries respectively tend to decline for this period. This apparent

TABLE 1. REGIONAL DIFFERENTIAL INDICATORS OF PER CAPITA INCOMES AND PRODUCTIVITIES

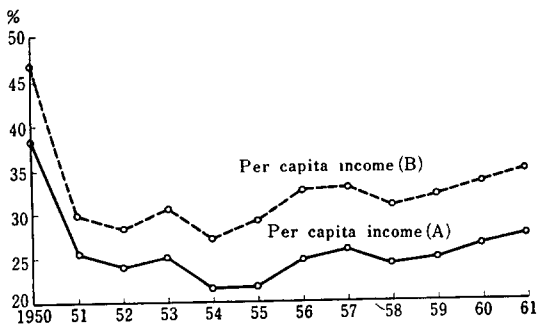
	Standard deviation					Coefficient of variation (%)				
	Per capita income		Gross value-added productivity			Per capita income		Gross value-added productivity		
	A	*B*	Manufacturing	Heavy ind.	Light ind.	*A*	*B*	Manufacturing	Heavy ind.	Light ind.
1950	12089	18850	52265	75127	48000	35.84	46.56	30.5	47.2	33.1
1951	10910	14445	81811	144083	73157	25.64	29.92	32.1	43.6	37.2
1952	12138	16065	78224	133124	61782	24.18	28.38	29.6	40.0	29.2
1953	14130	19405	93632	134213	66184	25.24	30.63	29.3	32.3	27.6
1954	13256	18617	104485	159135	81621	21.53	27.19	30.0	35.2	29.9
1955	14836	22252	109211	165928	76577	21.72	29.15	29.2	34.5	26.4
1956	18550	27742	113080	152076	79177	24.70	32.52	28.3	28.9	26.1
1957	21545	31168	114586	190774	84042	25.97	32.82	27.8	35.4	26.9
1958	20863	29971	130258	167126	81364	24.42	30.90	29.8	29.4	25.2
1959	23826	34813	149673	206235	88803	24.90	32.03	30.3	31.4	25.3
1960	29406	42577	184050	251921	103583	26.46	33.60	32.7	33.3	26.7
1961	36004	52114	203117	278029	119476	27.56	34.78	32.0	33.1	27.1

Sources: Income: Economic Planning Agency, *Kenminshotoku Suikei* (Estimate of Prefectural Incomes), 1963, and *Shōwa 37 nendo-ban, Kokuminshotoku Hakusho* (National Income Report, 1962); Gross value-added productivity: Ministry of International Trade and Industry, *Kōgyō Tōkeihyō* (Census of Manufactures). Gross value-added divided by employees.

Notes: 1. Heavy industry includes iron and steel, nonferrous metals, metal goods, machinery, electrical machinery, transportation equipment, optical, scientific and other machineries, chemicals, petroleum and coal products, pulp and papers, ceramics and weapons. Light industry includes others.

2. *A* is the standard deviation and the coefficient of variation based on the simple average M and *B* is those based on the weighted average $M_{\overline{w}}$, with 1955 population fixed.

FIG. 1. COEFFCIENT OF VARIATION OF PER CAPITA INCOMES AMONG PREFECTURES



discrepancy between the total coefficient and the partial coefficient may throw some doubt upon the computational accuracy, but there is no error.

The discrepancy is merely superficial and can be reconciled. When heavy and light industries are taken up separately, regional productivity differential in each should have been reduced, for not only have new big factories extended their locations beyond the existing industrial districts, but also new industrial districts have emerged in succession. Since the difference of productivities in the large enterprise level will not be so large, the extension of industrial districts will naturally have reduced the inter-regional differential in productivity. However, in the process of

heavy industrialization, there was an increasing proportion of heavy industry, the coefficient of variation of whose value-added productivity among prefectures was relatively higher. For instance, the coefficient of variation for heavy industry was 33.1% in 1961, but that for light industry was 27.1%. The increase of the former's proportional share, therefore, will automatically raise the coefficient of variation for manufacturing as a whole, even if the coefficients for heavy and light industries respectively are assumed to be constant. This latter effect can be called the "independent" effect accompanied by heavy industrialization. The reason why the coefficient of variation for manufacturing as a whole levels off can be explained by the fact that the declining tendency of the coefficients of variation for heavy and light industries respectively has been offset by the "independent", pure effect of heavy industrialization. In the earlier phase of this period, the coefficient of variation for manufacturing as a whole resembled that of light industry, while in the later period, the former coefficient tends to approach more closely to that of heavy industry. If we total the differences between the coefficients of variation for heavy and manufacturing industries, we have 52.3 points for 1950–55, but only 10.6 points for 1956–61. This substantiates cogently the above relationship.

The above conclusion may result in an instinctive and emotional resistance from many people, together with another conclusion that the interregional differential of prefectural per capita incomes has not expanded. However, the economist must be faithful to his analytical result, because we cannot deny the reliability of the Census of Manufactures, even if one may be skeptical toward some of prefectural income statistics. Be that as it may, we can derive an interesting conclusion that the heavy industrialization, by itself, will enlarge the interregional productivity differential through the shift-effect if other factors are equal. Therefore, we may have an inference that if the speed of heavy industrialization slows down in the future, we may even have a probability of the declining coefficient of variation for the interregional value-added per man in manufacturing. This is a point no one has been aware of so far.

However, the above conclusion that the regional differentials in terms of per capita income or value-added productivity have not so far been widened, relates to the 46 prefectures as a whole, while we may have an increasing differential among some prefectures and a reducing differential among other prefectures.

If we use the inter-prefectural coefficient of variation of per capita incomes (B indicator), the average of 1950–55 is 31.97, but that of 1956–61 is 32.78. This shows a slight increase of the indicator of the regional per capita income differential, as far as the observation of all 46 prefectures is concerned. But, in some prefectures, the differential may have been more advantageous, while in others, it may have been aggravated. Table 2 and Fig. 2 were prepared in order to make clear changing relative incomes of various prefectures from 1950–55 to 1956–61. On the horizontal axis, the relative incomes of prefectures in the former period (1950–55), i.e.,

$$\frac{\text{Per capita income in each prefecture}}{\left(\begin{array}{l}\text{Per capita average income of all}\\ \text{prefectures standardized each year}\\ \text{with prefectural populations of 1955}\\ \text{as the fixed weight}\end{array}\right)} \quad (1950\text{–}55 \text{ av.})$$

are measured, and on the vertical axis, the magnitudes of their changes from the former period (1950–55) to the latter (1956–61).

A casual look at the chart gives us a feeling that there is no clear-cut relationship. However, around the free-hand downward sloping curve in the third quadrant, sixteen prefectures

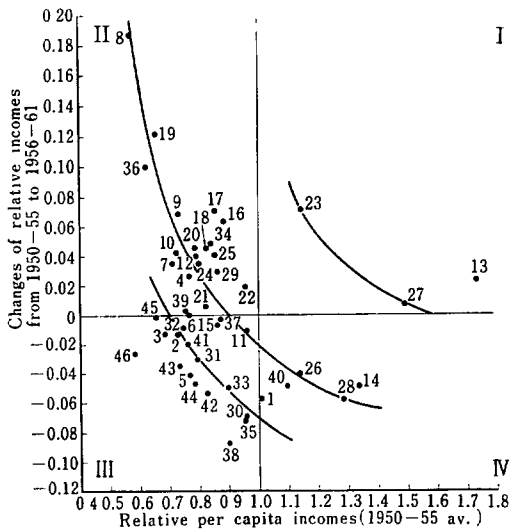
TABLE 2. CHANGES OF RELATIVE INCOMES OF VARIOUS PREFECTURES

Prefecture	(Per capita incomes in various prefectures) / (Standardized average of incomes of all prefectures)			Prefecture	(Per capita incomes in various prefectures) / (Standardized average of incomes of all prefectures)		
	1950–55 Av.	1956–61 Av.	Increase or Decrease		1950–55 Av.	1956–61 Av.	Increase or Decrease
Hokkaidō	1.0087	0.9321	−0.0766	Miye	0.8099	0.8432	0.0333
Aomori	0 7293	0.7051	−0.0242	Shıga	0.8595	0.8948	0.0353
Iwate	0.6915	0.6708	−0.0207	Kyōto	1.1339	1.0979	−0.0360
Miyagi	0.7765	0 7876	0.0111	Ōsaka	1.4806	1.5205	0.0399
Akita	0.7730	0.7145	−0.0585	Hyōgo	1.2714	1.2303	−0.0411
Yamagata	0.7677	0.7616	−0.0061	Nara	0.8658	0.8827	0.0169
Fukushima	0.7237	0.7387	0.0150	Wakayama	0.9612	0.8611	−0.1001
Ibaragi	0.6034	0.7545	0.1511	Tottori	0.8078	0.7261	−0.0817
Tochigi	0.7468	0.8034	0.0566	Shimane	0.7541	0.7279	−0.0262
Gunma	0 7413	0.7657	0.0244	Okayama	0.8973	0.8420	−0.0553
Saitama	0 9461	0.8615	−0.0846	Hiroshima	0.8448	0.8956	0.0508
Chiba	0.7999	0.8326	0.0327	Yamaguchi	0.9477	0 8744	−0.0733
Tōkyō	1.7304	1 7673	0.0369	Tokushima	0.6484	0.7315	0.0831
Kanagawa	1.3198	1.3201	0.0003	Kagawa	0.8753	0.8357	−0.0096
Niigata	0.8676	0 8491	−0.0185	Ehime	0.8942	0.8019	−0.0923
Toyama	0.9023	0 9604	0 0581	Kōchi	0.7551	0.7570	0.0019
Ishikawa	0.8632	0.9261	0.0629	Fukuoka	1.0820	1.0557	−0.0263
Fukui	0.8420	0.8549	0.0129	Saga	0.7708	0.7192	−0.0516
Yamanashi	0.6743	0.7931	0.1188	Nagasaki	0.8252	0.7576	−0.0676
Nagano	0.7966	0.8266	0.0300	Kumamoto	0.7429	0.6799	−0.0630
Gifu	0.8190	0.8249	0.0059	Ōita	0.7857	0.7172	−0.0685
Shizuoka	0.9531	0.9895	0.0364	Miyazaki	0.6564	0.6511	−0.0053
Aichi	1.1444	1.2378	0.0934	Kagoshima	0.5860	0.5513	−0.0347

get together, except for Kagoshima and Ehime which are slightly deviated from the line. Insofar as these sixteen prefectures are concerned, there was a tendency, on the one hand, that in those prefectures in which the relative incomes were relatively higher in 1950–55, they have larger declines in their relative incomes from 1950–55 to 1956–61. On the other hand, in those prefectures of which the relative incomes were relatively lower in the former period, their declines in the relative incomes were smaller. In other words, we find that among the sixteen prefectures, there prevailed an equalizing tendency of per capita incomes. This is the first noticeable relationship we find in Fig. 2, and we can mention the following sixteen prefectures as belonging to this group: Miyazaki, Iwate, Kōchi, Yamagata, Shimane, Aomori, Saga, Tottori, Kumamoto, Akita, Ōita, Nagasaki, Okayama, Wakayama, Yamaguchi and Hokkaidō.

Although we see an intra-group equalization in the above group, since the prefectures belonging to this group are almost those whose relative incomes were less than unity in 1950–55 and tended to decline further in the latter period, we can say that their relative incomes as a group were aggravated compared with the national average. Therefore, the group of

FIG. 2. DIRECTION OF CHANGES IN RELATIVE PER CAPITA INCOMES OF VARIOUS PREFECTURES



I	13.	Tōkyō	23.	Aichi	
	27.	Ōsaka			
II	4.	Miyagi	7.	Fukushima	
	8.	Ibaragi	9.	Tochigi	
	10.	Gunma	12.	Chiba	
	16.	Toyama	17.	Ishikawa	
	18.	Fukui	19.	Yamanashi	
	20.	Nagano	21.	Gifu	
	22.	Shizuoka	24.	Miye	
	25.	Shiga	29.	Nara	
	34.	Hiroshima	36.	Tokushima	
	39.	Kōchi	45.	Miyazaki	
III	2.	Aomori	3.	Iwate	
	5.	Akita	6.	Yamagata	
	11.	Saitama	15.	Niigata	
	30.	Wakayama	31.	Tottori	
	32.	Shimane	33.	Okayama	
	35.	Yamaguchi	37.	Kagawa	
	38.	Ehime	41.	Saga	
	42.	Nagasaki	43.	Kumamoto	
	44.	Ōita	46.	Kagoshima	
IV	1.	Hokkaidō	14.	Kanagawa	
	26.	Kyōto	28.	Hyōgo	
	40.	Fukuoka			

these prefectures manifests an intra-group equalization, but an inter-group aggravation in their relative incomes. It is of immense interest to see that in this group a lot of undeveloped prefectures in Kyūshū and Tōhoku are involved.

Second, we can draw another free-hand downward sloping line through the second and fourth quadrants. There are twenty-two prefectures closely scattered along this line — putting aside a bit deviated prefectures, Ishikawa, Toyama and Shizuoka — as follows: Ibaragi, Yamanashi, Tokushima, Tochigi, Hiroshima*, Nagano, Fukui, Shiga, Chiba*, Miye*, Nara, Gunma, Fukushima, Miyagi, Gifu*, Kagawa, Niigata, Saitama, Kyōto*, Fukuoka*, Kanagawa* and Hyōgo*.

We find again an equalizing tendency of their relative incomes among twenty-two prefectures, but some involved in this group are relatively industrialized prefectures, such as Hiroshima, Chiba, Miye, Gifu, Kanagawa, Hyōgo, etc. (with *). Within this group, it is evident that the per capita income equalization has proceeded, but between this group and another aforementioned group, mostly consisting of prefectures in Tōhoku and Kyūshū, we see a widening gap in their relative incomes. It may be a bit sweeping a generalization to say that within relatively industrialized prefectures as well as within less industrialized ones, we have an equalizing tendency of relative incomes, but that between the above two groups the per capita income differential tends to have increased. However, although accompanied by some exceptions, this seems to be an essential tendency, and the apparent stability of the coefficient of variation among prefectural per capita incomes can be presumed to have come up by offsetting with each other the above equalizing and widening tendencies of income differentials.

Third, Tōkyō, Ōsaka and Aichi are prefectures whose relative incomes are among the top. In Fig. 2, their relative incomes increased for this period. This is because we used the average of 1956–61 as the latter period, but if we take up the average of 1955–59, Tōkyō's relative income will indicate a slight decline.

We can present a similar analysis in relation to the regional differential of the gross value-

added productivity in manufacturing. Table 3 is based upon the gross value-added per employee and computes changes of the relative value-added productivity of various prefectures from 1950–55 to 1956–61. The denominator of the relative productivity is the average of productivities in all prefectures standardized each year with manufacturing employees of 1955 as the fixed weight. With respect to the "relative" gross value-added productivity, we have derived the 1950–55 average and the 1956–61 average and checked changes between the two period.

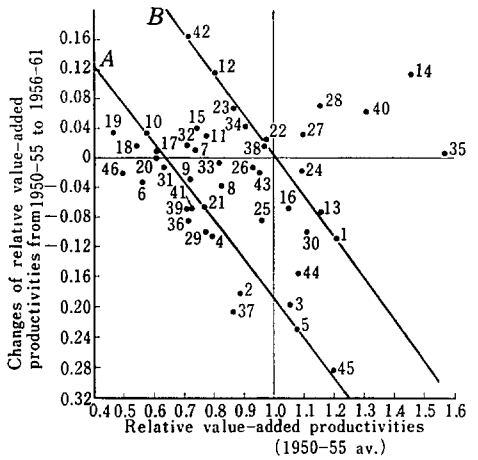
TABLE 3. GROSS VALUE-ADDED PRODUCTIVITY IN EACH PREFECTURE RELATIVE TO THE STANDARDIZED AVERAGE OF ALL PREFECTURES

—Manufacturing—

Prefecture	1950–55 Av.	1956–61 Av.	Increase or Decrease	Prefecture	1950–55 Av.	1956–61 Av.	Increase or Decrease
Hokkaidō	1.2121	1.1045	−0.1076	Miye	1.0950	1.0774	−0.0176
Aomori	0 8877	0.7054	−0.1823	Shiga	0.9615	0.8772	−0.0843
Iwate	1.0542	0.8567	−0.1975	Kyōto	0.9334	0.9184	−0.0150
Miyagi	0.7966	0.6902	−0.1064	Ōsaka	1.0986	1.1317	0.0331
Akita	1.0792	0.8504	−0.2288	Hyōgo	1.1548	1.2274	0.0726
Yamagata	0.5627	0.5302	−0.0325	Nara	0.7746	0.6744	−0.1002
Fukushima	0.7408	0.7518	0.0110	Wakayama	1.1127	1.0130	−0.0997
Ibaragi	0.8274	0.7982	−0.0382	Tottori	0.6335	0.6188	−0.0147
Tochigi	0.7198	0.6911	−0.0287	Shimane	0.7132	0.7298	0.0166
Gunma	0.5763	0.6090	0.0327	Okayama	0.8178	0.8112	−0 0066
Saitama	0.7785	0.8088	0.0303	Hiroshima	0.9073	0.9502	0.0429
Chiba	0.8022	0.9187	0.1165	Yamaguchi	1.5749	1.5789	0.0040
Tōkyō	1.1555	1.0838	−0.0717	Tokushima	0.7139	0.6285	−0.0854
Kanagawa	1.4576	1.5754	0.1178	Kagawa	0.8652	0.6589	−0.2063
Niigata	0.7509	0.7910	0.0401	Ehime	0.9756	1.0010	0.0254
Toyama	1.0512	0.9832	−0.0680	Kōchi	0.7188	0.6490	−0.0698
Ishikawa	0.6107	0.6197	0.0090	Fukuoka	1.3109	1.3741	0.0632
Fukui	0.5439	0.5608	0.0169	Saga	0.7232	0.6537	−0.0695
Yamanashi	0.4629	0.4961	0.0332	Nagasaki	0.7122	0.8796	0 1677
Nagano	0.6096	0.6096	0	Kumamoto	0.9522	0.9321	−0.0201
Gifu	0.7671	0.7002	−0.0669	Ōita	1.0816	0.9282	−0.1534
Shizuoka	0.9712	0.9873	0.0161	Miyazaki	1.2027	0.9193	−0.2834
Aichi	0.8700	0.9380	0 0680	Kagoshima	0.4966	0.4751	−0.0215

Fig. 3 is depicted as based on Table 3. Fig. 3 gives us again an interesting result. We find in the same way as in Fig. 2, relatively less industrialized prefectures scattered around the downward sloping line *A*. These prefectures amount to twenty-three: Miyazaki, Akita, Iwate, Ōita, Aomori, Kagawa, Miyagi, Nara, Gifu, Kōchi, Saga, Tokushima, Tochigi, Yamagata, Tottori, Nagano, Ishikawa, Fukui, Gunma, Yamanashi, Shimane, Fukushima and Ibaragi. These are less industrialized or are centered on the light industry. That among these prefectures they have a downward sloping line demonstrates very evidently that there was a tendency for the value-added productivities of these twenty-three prefectures to equalize from 1950–55 to 1956–61

FIG. 3. DIRECTION OF CHANGES IN RELATIVE VALUE-ADDED PRODUCTIVITIES OF VARIOUS PREFECTURES



1. Hokkaidō
2. Aomori
3. Iwate
4. Miyagi
5. Akita
6. Yamagata
7. Fukushima
8. Ibaragi
9. Tochigi
10. Gunma
11. Saitama
12. Chiba
13. Tōkyō
14. Kanagawa
15. Niigata
16. Toyama
17. Ishikawa
18. Fukui
19. Yamanashi
20. Nagano
21. Gifu
22. Shizuoka
23. Aichi
24. Miye
25. Shiga
26. Kyōto
27. Ōsaka
28. Hyōgo
29. Nara
30. Wakayama
31. Tottori
32. Shimane
33. Okayama
34. Hiroshima
35. Yamaguchi
36. Tokushima
37. Kagawa
38. Ehime
39. Kōchi
40. Fukuoka
41. Saga
42. Nagasaki
43. Kumamoto
44. Ōita
45. Miyazaki
46. Kagoshima

Going to the upper line *B*, prefectures surrounding it can be mentioned as follows: Nagasaki, Chiba, Aichi, Hiroshima, Shizuoka, Ehime, Miye, Ōsaka, Toyama, Tōkyō, Wakayama and Hokkaidō. All of them are not always industrialized prefectures, but mostly so, and include newly developed industrial prefectures, focussing on heavy industry. That these are connected with each other by the downward sloping curve will again suggest the existence of a narrowing tendency of the regional productivity differential among relatively industrialized prefectures.

The other four prefectures, Yamaguchi, Kanagawa, Fukuoka and Hyōgo, are all within the first quadrant, demonstrating that these prefectures with remarkably high relative productivities are further widening the productivity differential with other prefectures.

Our analysis, thus, indicates that, on the one hand, among industrialized prefectures, particularly among heavy industry prefectures, there was a tendency for their value-added productivities to equalize with each other, while, on the other, among less industrialized prefectures too, there was the same equalizing tendency. But, as if offsetting these equalizing tendencies within each group, we have an increasing gap of productivities between the industrialized group and the less industrialized one. In other words, heterogeneous two tendencies within the group and between the groups are mutually cancelled out, and so we get an overall constancy of the coefficient of variation of value-added productivities among forty-six prefectures.

It is exceedingly interesting that the apparent constancy of the overall indicator of regional productivity differential has concealed the two opposite tendencies: the equalization as well as the aggravation of the regional differentials. Taking into account that the relatively industrialized prefectures in Fig. 3 are mostly the heavy-industry prefectures, our already explained proposition that heavy industrialization plays a "differential-aggravating" role, if its pure "independent" effect is taken out, seems to be further strengthened.

In order to check the above consequences, we shall present here a different type of analysis. This is a computation of the elasticity of employment with respect to the gross value-added in manufacturing.

We get the following cross-section results among forty-six prefectures as to the three years

between the number of employees N and the gross value-added V in manufacturing.

1951 $\log N = -0.00320 + 0.723 \log V$, $R^2 = 0.800$

1955 $\log N = -0.00481 + 0.814 \log V$, $R^2 = 0.940$

1959 $\log N = -0.00557 + 0.807 \text{ lag } V$, $R^2 = 0.949$

In other words, the cross-section elasticity of employment with respect to the value-added is about 0.7–0.8. However, if we compute the time-series elasticity of employment for 1950–59, we have a different result as is shown in Table 4.

TABLE 4. TIME-SERIES ELASTICITY OF EMPLOYMENT FOR 1950–59
— $\log N = a + b \log V$ —

Prefecture	b	R^2	Prefecture	b	R^2
Hokkaidō	0.269	0.744	Miye	0.229	0.905
Aomori	0.329	0.816	Shiga	0.223	0.867
Iwate	0.351	0.903	Kyōto	0.383	0.946
Miyagi	0.444	0.921	Ōsaka	0.386	0.961
Akita	0.340	0.835	Hyōgo	0.274	0.905
Yamagata	0.326	0.889	Nara	0.263	0.646
Fukushima	0.257	0.862	Wakayama	0.329	0.864
Ibaragi	0.365	0.831	Tottori	0.271	0.877
Tochigi	0.352	0.869	Shimane	0.250	0.968
Gunma	0.316	0.902	Okayama	0.272	0.884
Saitama	0.363	0.960	Hiroshima	0.314	0.929
Chiba	0.353	0.956	Yamaguchi	0.211	0.745
Tōkyō	0.500	0.972	Tokushima	0.242	0.599
Kanagawa	0.365	0.923	Kagawa	0.301	0.820
Niigata	0.273	0.926	Ehime	0.183	0.785
Toyama	0.227	0.688	Kōchi	0.188	0.849
Ishikawa	0.285	0.884	Fukuoka	0.168	0.703
Fukui	0.191	0.685	Saga	0.268	0.810
Yamanashi	0.208	0.925	Nagasaki	0.102	0.451
Nagano	0.294	0.847	Kumamoto	0.177	0.857
Gifu	0.353	0.842	Ōita	0.214	0.885
Shizuoka	0.371	0.963	Miyazaki	0.164	0.720
Aichi	0.368	0.976	Kagoshima	0.352	0.977

Source: Based on the Census of Manufactures.

Note: The gross value-added based on the Census of Manufactures for 1950–59 was deflated by the wholesale price index for manufacturing commodities.

The impression from Table 4 can be summarized as follows:

1) The cross-section elasticity of employment is about 0.7–0.8, while the time-series elasticity is very low from 0.1 to 0.5. Probably, if we compute it for the former period (1950–55) and the latter (1956–61), then the elasticity will be naturally higher in the latter period, in view of the employment tendency. Nevertheless, the fact that the time-series elasticity is far lower remains unshakable. This may be due to the extraodinarily rapid expansion of productivity in manufacturing for 1950–59, and to the fact that the slope fitted for the employees-gross

value-added for 1950–59 is much steeper than that fitted among prefectures.

2) Putting aside Kyūshū and Shikoku, the elasticity for Miyagi is 0.444, the highest in the Tōhoku district, that for Tōkyō is 0.500, the highest in the Kantō district, and those for Shizuoka and Aichi are 0.371 and 0.368 respectively, belonging to the highest in the Chūbu district. Furthermore, in Kansai district, Ōsaka is 0.386, the highest. These demonstrate that the center of each district has a very high employment elasticity, and one of the reasons for this may be that in the central city of the district the small-medium enterprises with highly labor-intensive technique congregate which are under the subcontract of large enterprises. This entails high absorption of employment, increasing the elasticity of employment, particularly in machinery industry.

3) In Tōhoku, the time-series elasticity of employment is more than 0.3 in almost every prefecture, but the number of prefectures in Kyūshū and Shikoku, the elasticity of which is in the range of 0.1~0.2, amounts to six. This constitutes a tremendous difference. We shall check this phenomenon by the changes of relative productivities in these prefectures from 1950–55 to 1956–61, as based on the data mentioned in Table 3.

[Tōhoku district]		[Shikoku district]		[Kyūshū district]	
Aomori	−0.1823	Tokushima	−0.0854	Fukuoka	0.0632
Iwate	−0.1975	Kagawa	−0.2063	Saga	−0.0695
Miyagi	−0.1064	Kōchi	−0.0698	Nagasaki	0.1677
Akita	−0.2288	Ehime	0.0254	Kumamoto	−0.0201
Yamagata	−0.0325			Ōita	−0.1534
Fukushima	0.0110			Miyazaki	−0.2834
				Kagoshima	−0.0215

The declines of relative productivities seem to be larger in the Tōhoku district than in the Kyūshū and Shikoku districts, which explains why the elasticities of employment are higher in the Tōhoku district. The thread of connection between the two statistical data cannot be made clear perfectly without going into the breakdowns of industries, but we shall stop here.

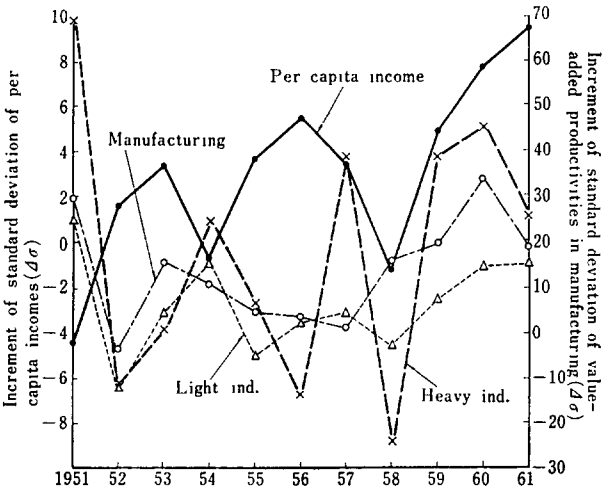
4) The fact that the cross-section elasticity of employment is relatively stable for 0.7 to 0.8 suggests that the regional differential of value-added productivity in manufacturing has not indicated any conspicuous change for the past ten years and coincides very closely with the relative constancy of the coefficient of variation of value-added productivity computed among forty-six prefectures.

III. *Cyclical Changes of Indicator on the Regional Differential and Concentration*

As indicated in Fig. 1, the coefficient of variation of per capita incomes, as an indicator of regional differential, moves concomitantly with the actual business cycle, but the same coefficient of the value-added productivity (not only in manufacturing as a whole but also in heavy and light industries) does not necessarily correspond to the business cycle.

Therefore, we depict the increase or decrease of the standard deviation of per capita income and value-added productivity in Fig. 4. Although the increment of the standard deviation of per capita incomes fluctuates very clearly together with actual business cycle, that of

FIG. 4. INCREMENTAL FLUCTUATIONS IN THE STANDARD DEVIATIONS OF PER CAPITA INCOMES AND PRODUCTIVITIES IN MANUFACTURING AMONG PREFECTURES



value-added productivity moves in an irregular way.

Consequently, we have proceeded further to check the standard deviations of population, prefectural income, employees, and gross value-added, respectively. Since the per capita income and the value-added productivity are the ratios of two magnitudes, the increment of their standard deviations may not reflect the business cycle, even when the standard deviations of their numerator and denominator reflect it very will.

According to Table 5, both the standard deviations and the coefficients of variation of

FIG. 5. CHANGES IN THE STANDARD DEVIATIONS OF POPULATIONS AND INCOMES AMONG PREFECTURES

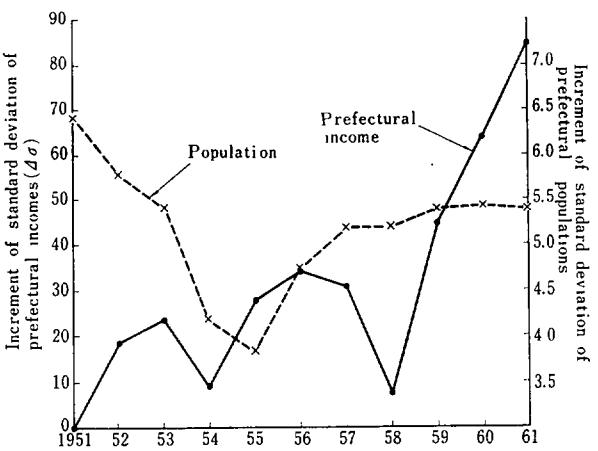


TABLE 5. INDICATORS OF REGIONAL CONCENTRATION OF POPULATION, VALUE-ADDED AND INCOME

	Employees in manufacturing			Employees in heavy industry			Employees in light industry			Population		
	Standard deviation	Mean	Coefficient of variation	Standard deviation	Mean	Coefficient of variation	Standard deviation	Mean	Coefficient of variation	Standard deviation	Mean	Coefficient of variation
	$\times 10^3$	$\times 10^3$	%	$\times 10^3$	$\times 10^3$	%	$\times 10^3$	$\times 10^3$	%	$\times 10^4$	$\times 10^4$	%
1950	94.58	83.93	112.7	57.34	41.58	137.9	40.32	42.32	95.3	108.16	180.87	59.8
1951	107.26	92.12	116.4	64.12	45.37	141.3	46.63	46.71	99.8	114.59	183.78	62.4
1952	112.95	93.61	120.7	67.20	46.35	145.0	49 23	47.20	104.3	120.39	186.54	64.5
1953	127.56	101.26	126.0	75.36	50.49	149.3	55.80	50.73	110.0	125.82	189.09	66.5
1954	130.89	102.98	127.1	76.00	50.22	151.3	58.29	52.70	110.6	130.02	191.82	67.8
1955	139.72	107.78	129.6	80.79	52.33	154.4	62.34	55.40	112.5	133.87	194.08	69.0
1956	159.63	119.70	133.4	94.56	59.66	158.5	68.80	59.99	114.7	138.61	196.02	70.7
1957	179.02	131.35	136.3	107.61	66.73	161.3	75.50	64.54	117.0	143.80	197.66	72.8
1958	185.12	132.86	139.3	112.26	68.28	164.4	76.70	64.49	118.9	149.01	199.48	74.7
1959	205.27	146.75	139.9	128.51	77.78	165.2	81.29	68.88	118.0	154.40	214.42	76.7
1960	231.21	165.26	139.9	148.11	90.02	164.5	88.09	75.24	117.1	159.83	203 08	78.7
1961	246.22	178.01	138.3	160.96	100.10	160.8	90.38	77.92	116.0	165.24	204.97	80.6

(Unit : yen)

	Gross value-added in manufacturing			Gross value-added in heavy industry			Gross value-added in light industry			Income		
	Standard deviation	Mean	Coefficient of variation	Standard deviation	Mean	Coefficient of variation	Standard deviation	Mean	Coefficient of variation	Standard deviation	Mean	Coefficient of variation
	$\times 10^9$	$\times 10^9$	%	$\times 10^9$	$\times 10^9$	%	$\times 10^9$	$\times 10^9$	%	$\times 10^9$	$\times 10^9$	%
1950	20.67	15.88	130.1	13.18	9.10	144.8	8.23	6.79	121.3	87.69	71.06	123.4
1951	33.66	25.62	131.4	22.19	15.57	142.5	12.55	10.05	124.9	87.57	85.59	100.0
1952	40.29	28.42	141.7	25.77	16.92	152.3	15.47	11.50	134.6	105.73	104 76	100.9
1953	52.27	36.63	142.7	34.30	22.67	151.3	19.55	13.96	140.0	129.23	119.36	108.3
1954	60.86	41.19	147.8	38.30	24.58	155.8	23.89	16.61	143.8	138.35	131.01	105.6
1955	66.53	45.31	146.8	41.55	26.75	155.3	26.60	18.56	143.4	166.31	148.13	112.3
1956	83.83	55.26	151.7	54.56	34.18	159.6	30.99	21.08	147.0	200.70	167.88	119.5
1957	101.10	63.77	158.5	68.08	40.52	168.0	34.46	23.25	148.2	231.69	189.38	122.3
1958	110.04	68.86	159.8	74.78	44.49	168.1	37.34	24.37	153.2	239.42	195.85	122.2
1959	130.40	83.59	156.0	91.64	55.59	164.8	40.96	28.00	146.3	283.94	222.70	127.5
1960	171.52	109.45	156.7	122.79	74.80	164.2	51.58	34.64	148.9	347.76	263.43	132.0
1961	212.31	134.56	157.8	152.98	93.23	164.1	63.22	41.33	153.0	432.83	316.27	136.9

those magnitudes indicate a rising trend for 1950-61. The fact that the coefficient of variation is rising stands for the increasing regional concentration in terms of these variables. Taking the year-by-year increments of these standard deviations, Figs. 5~7 are constructed. In Fig. 5, it is interesting to see, on the one hand, that the increment of the standard deviation of population among prefectures are decreasing until 1955, and then turn to a rising tendency. This turning point, 1955, exactly coincides with the time of jump of the *GNP* growth rate from about 7% for 1950-55 to 10% for 1956-61. Thus, the transition to the phase of higher growth rate seems to affect the incremental behavior of the regional population distribution very vividly. On the other hand, the increment of the standard deviation of the prefectural incomes is in perfect agreement with the actual business fluctuations. As to why changes of the standard deviation of per capita incomes are cyclical may be due to the fact that those of prefectural incomes are cyclical but those of prefectural populations are free from the influence of short-run cycles.

In Fig. 6 and 7, we have depicted the increments of the standard deviations of employees

FIG. 6. CHANGES IN THE STANDARD DEVIATION OF EMPLOYEES IN MANUFACTURING AMONG PREFECTURES

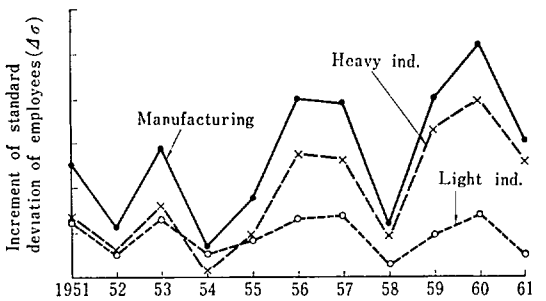
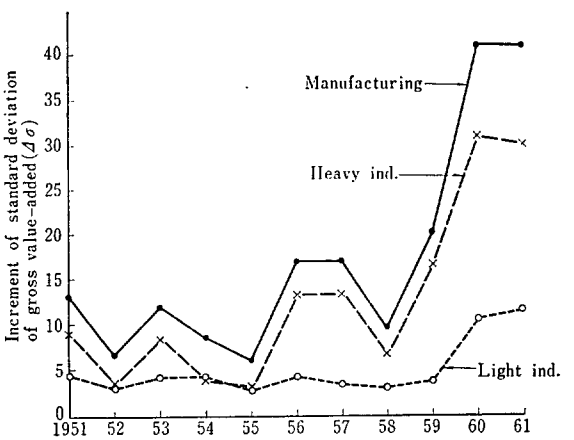


FIG. 7. CHANGES IN THE STANDARD DEVIATION OF GROSS VALUE-ADDED IN MANUFACTURING AMONG PREFECTURES



and the gross value-added in manufacturing, as well as heavy and light industries. Although we could not see any regular cycles in the increment of the standard deviation of value-added productivity in Fig. 4, we now find markedly regular cycles in the increments of the standard deviations of the value-added and employees themselves in Fig. 6 and 7, particularly as concerns heavy industry. Consequently, the lack of a regular cycle in the increment of the value-added productivity may be due to the mutual cancellation of cycles of its numerator and denominator.

IV. *Regional Differences of the Industrial Structure*

In the international comparison of the industrial structure of various countries, we can find some empirical law in the relationship between the per capita national income and the industrial structure of each country. In the same way, we may find some empirical relationship between the per capita prefectural income and the industrial structure of each prefecture, e.g., in Kagoshima the proportion of the primary industry is much higher than in Tokyo.

FIG. 8. PER CAPITA PREFECTURAL INCOMES AND THE INCOME PROPORTIONS OF THE PRIMARY INDUSTRY, IN 1960

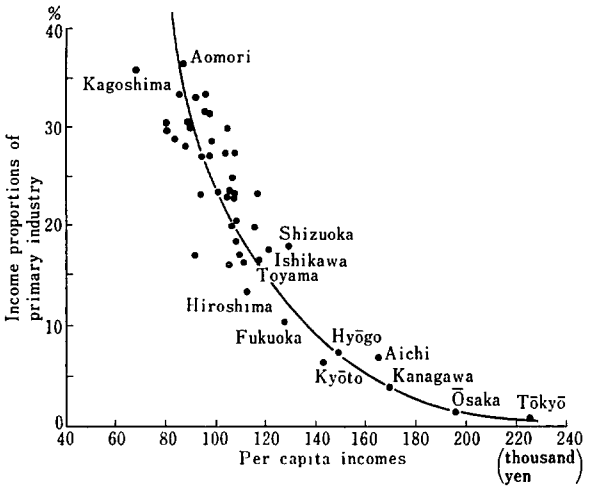
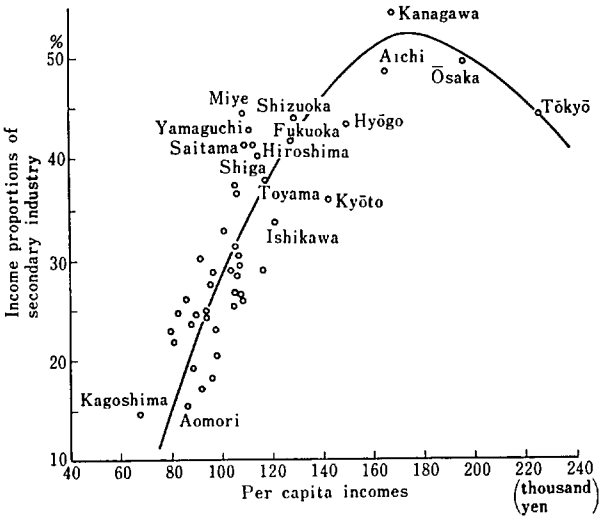


Fig. 8 shows that the proportion of the primary industry in terms of prefectural "income produced" has a declining tendency as we move to higher per capita income. On the contrary, Fig. 9 makes clear that the proportion of the secondary industry in terms of the same has an increasing tendency. However, very interesting is the fact that the income proportion of the secondary industry is rising up to Kanagawa prefecture, and then bending down to Ōsaka and Tōkyō. This is a point to be noticed in the interregional comparison of industrial structure, because Tōkyō or Ōsaka, with excessive concentration of population, may develop as big cities focussing much more on the tertiary industry than on the secondary industry. Except for these two, we may say in general that the prefecture with higher per capita income is more industrialized and vice versa, and the proportion of the primary industry declines in

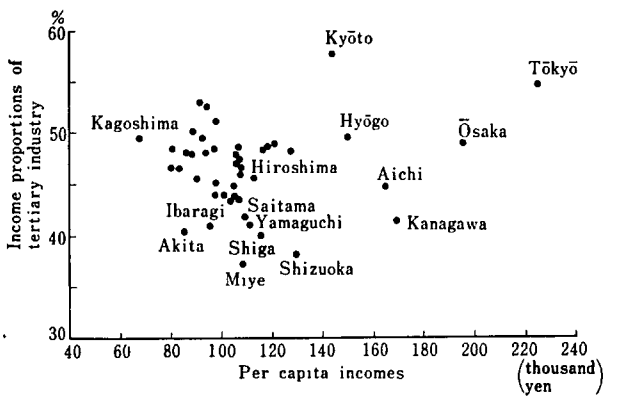
FIG. 9. PER CAPITA PREFECTURAL INCOMES AND THE INCOME PROPORTIONS OF THE SECONDARY INDUSTRY, IN 1960



inverse proportion to the degree of industrialization. From this point of view, the policy which makes possible the regional dispersion of industry will be a first step toward the improvement of regional differentials.

Moving to Fig. 10, it is also interesting to see that there are no systematic relation between the income proportion of the tertiary industry and the per capita prefectural income. However, in Fig. 11 in which the labor force proportion of the tertiary industry is correlated with the per capita income, some systematic relations can be derived, i.e., the share is rising as the per capita income increases. Also interesting is the fact that tourist resorts like, Kyōto,

FIG. 10. PER CAPITA PREFECTURAL INCOMES AND THE INCOME PROPORTIONS OF THE TERTIARY INDUSTRY, IN 1960



Nara, Nagasaki, Kumamoto, etc., are rather upwardly deviated from the free-hand line.

As is well known, the same relation can be derived also from international comparison as well as the long-term analysis. If we denote the income proportion of the tertiary industry as Y_3/Y, and the labor force proportion of it as L_3/L, then the ratio of the two will indicate the comparative productivity of the tertiary industry, for the relation will identically hold true.

$$Y_3/Y \div L_3/L \equiv \frac{Y_3}{L_3} \Big/ \frac{Y}{L}$$

Since Y_3/Y merely scatters, quite arbitrarily, with respect to the increase of per capita income, but L_3/L rises fairly systematically as is indicated in Fig. 11, the comparative productivity $(Y_3/Y \div L_3/L)$ will necessarily tend to decline as the per capita income rises. Fig. 12 shows this relationship in 1960. The split into two curves is worth noticing, for along the

FIG. 11. PER CAPITA PREFECTURAL INCOMES AND THE LABOR FORCE PROPORTIONS OF THE TERTIARY INDUSTRY, IN 1960

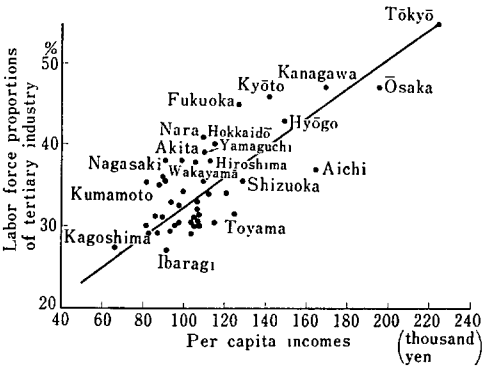
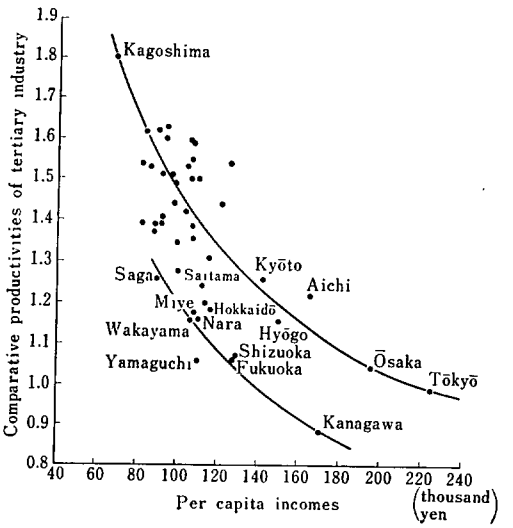


FIG. 12. DECLINING TENDENCY OF COMPARATIVE PRODUCTIVITY OF THE TERTIARY INDUSTRY, IN 1960



lower curve, we see a relatively heavy-industrial prefectures scattered, such as Kanagawa, Fukuoka, Shizuoka, Yamaguchi, Wakayama and Miye. These and others, thus, compose two groups. Most interesting is the fact that we have only one declining curve connecting the comparative productivity and the per capita income in 1955, yet in 1960 after the unprecedented investment boom, the curve is decomposed into two parts. In view of the fact that along the lower curve the heavy-industry prefecture scatters, this split is assumed as a consequence of the rapid heavy industrialization. As the per capita income is lower, the comparative productivity of the tertiary industry will be higher. This is quite in common with the consequence of international or long-term analyses. However, the split into two curves is very peculiar, reflecting an unprecedented, rapid heavy industrialization for 1955–61.

Of course, the declining tendency of comparative productivity in the tertiary industry, as per capita income rises, is subject to considerable deviations. Therefore, the fifteen prefectures are selected in Table 6, laying an emphasis on the three groups consisting typically of 1) high per capita income prefectures, 2) newly industrialized, medium per capita income prefectures, and 3) underdeveloped prefectures. Among the fifteen prefectures in Fig. 6, the comparative productivity of the tertiary industry to all industries tends to increase as we move to the lower-productivity prefectures, although it is not a strongly coherent relation. However, if the comparative productivity of the tertiary industry as a ratio to the secondary industry is computed (column 2), we cannot find so obvious a tendency as can be seen in the column 1 of Table 6 for the comparative productivities (as compared with all industries); 136.8 of Ōita and 139.2 of Kumamoto are reduced to 93.6 and 89.1 in terms of those (as compared with the

TABLE 6. SOME ASPECTS OF COMPARATIVE PRODUCTIVITIES, IN 1960

	Tertiary ind. / All ind. (1)	Tertiary ind. / Second ind. (2)	Primary ind. / Second ind. (3)	Incomes per employed labor force in all ind. (4)
Tōkyō	99.4%	95.9%	43.0%	484 thousand yen
Ōsaka	104.5	102.7	33.9	448
Aichi	122.0	112.2	33.3	328
Kanagawa	88.5	69.5	30.8	437
Hyōgo	115.6	98.5	30.2	320
Hiroshima	120.1	86.3	29.4*	253
Yamaguchi	105.8	62.7	26.8*	283
Miye	117.5	69.4	25.7*	252
Kagawa	149.9	125.3	40.2	228
Fukushima	163.0	122.9	39.3	219
Tottori	139.1	135.1	67.8	192
Ōita	136.8	93.6	39.6	203
Aomori	153.3	111.9	46.4	193
Kumamato	139.2	89.1	36.9	199
Kagoshima	177.4	145.4	48.7	145

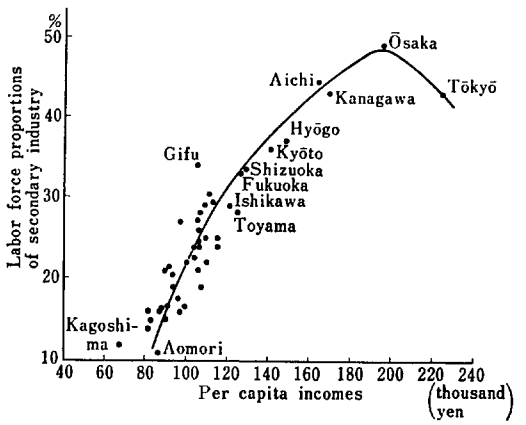
Note: The comparative productivities (Primary ind./second. ind.) in 1955 of the three prefectures with * were 34.0%, 32.4%, and 22.0% respectively, so it can be presumed that especially in Hiroshima and Yamaguchi the widening of the differential between the secondary and the primary industries was conspicuous in the high-pitched growth period of 1955–60.

secondary industry). It is to be emphasized that in such a heavy-industrial prefecture, as Kanagawa, Yamaguchi and Miye, the comparative productivity of the tertiary industry in the column 2 definition is extremely low.

There is another notable point in Table 6. In Hiroshima, Yamaguchi and Miye, the incomes per capita of labor force in all industries are in the range of 250–280 thousand yen, locating themselves in the medium position in all prefectures. However, these prefectures have been in transition toward becoming the new industrial districts, centering on heavy industry. It is very striking to see that as a consequence, the productivity differential between agriculture and industry has been much more aggravated in these prefectures. In these three prefectures with * in column 3, the above productivity differential (the primary vs. the secondary) is in the range of 25–29%, and the lowest among the selected fifteeen prefectures.

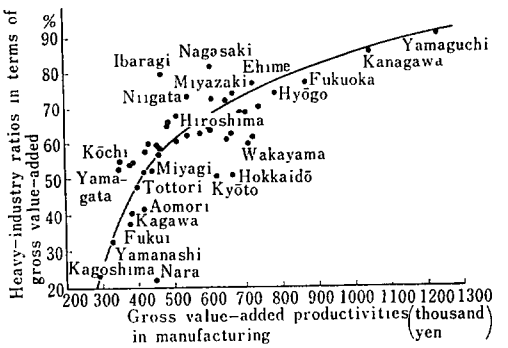
According to an international comparison, the proportion of the secondary industry in terms of employed labor force is not closely correlated with the per capita income. Therefore, although Y_2/Y is higher in the country of higher per capita income, L_2/L is indefinite with respect to an increase of per capita income (a bit flat tendency on the graph, although dispersed widely). Consequently, the comparative procuctivity of the secondary industry tends to increase as the per capita income becomes higher. However, when the counterpart relation is drawn of Fig. 13 as to the inter-regional data, we are struck with a new fact. The chart for the proportion of the secondary industry in terms of employed labor force seems to have a rather higher correlation than that in terms of income, with a steeply rising curve to the left. Fig. 13 shows an excellent fit beyond our expectation, with forty-five prefectures closely clustered around a curve, but with an only exception as concerns Tōkyō. Why we can derive an opposite conclusion to the international or time-series analyses from the cross-section analysis among prefectures is hard to make clear. Tentatively, we feel that since the productivity-dispersion between its highest and lowest prefectures is not so wide as in the long-term or international analyses, the regional dispersion of productivity will not offset the regional distribution of employment. There seems to remain much to be discussed in this problem, but we shall not go into detail.

FIG. 13. PER CAPITA PREFECTURAL INCOMES AND THE LABOR FORCE PROPORTION OF THE SECONDARY INDUSTRY, IN 1960



With respect to the secondary industry, we have another problem to be explored. This is relative to the heavy-industry ratio. Fig. 14 elucidates the relation between the heavy-industry ratio in terms of the gross value-added and the gross value-added per employee. We have a positive correlation between the two, but in relation to prefectures whose value-added productivity is in the range of 400–600 thousand yen, the dispersion from the fitted line seems to be so high. However, the productivity of heavy industry is higher without exception than that of light industry in any prefecture, and this seems to be one of the causes why we had a positive correlation between them.

FIG. 14. VALUE-ADDED PRODUCTIVITIES IN MAMUFACTURING AND THE HEAVY-INDUSTRY RATIO, IN 1960



How is the rank of prefectures in terms of the manufacturing gross value-added productivity or the heavy-industry ratio connected with their rank in terms of the per capita income level? Yamaguchi prefecture which is the highest in Japan in terms of the gross value-added productivity ranks only the twentieth in her per capita income level in 1959. This is a noteworthy phenomenon. In general, the productivity in manufacturing is higher in prefectures located in the industrial districts surrounding big cities, like Chiba, Kanagawa, Wakayama, Yamaguchi, etc. This is in terms of productivity and not in terms of shipment or value-added.

The apparent difference between productivity and per capita income in the rank will be, of course, due to the fact that in the determination of per capita income level, the productivities in the primary and tertiary industries also take part. However, there is a very important point which has been long ignored. Table 7 is the result of computation in 1959 of the ratio of manufacturing income (based on the prefectural income statistics) to gross value-added (based on the Census of Manufactures). When both are compared, (1) the gross value-added includes depreciation charges, but the manufacturing income does not, (2) in the former, the overhead cost, such as advertisement cost, rent, freight, reception expenses, insurance premium, etc., i.e., the outflow to the tertiary industry, is included, but from the latter they are excluded. (3) Gross value-added is based on the Census of Manufactures, covering only the establishments with four employees and over, but the manufacturing income covers all of the establishments. Although the third factor makes the manufacturing income larger than the gross value-added, the first and second factors play a role of reducing the level of manufacturing income than the gross value-added. Income consists of wages and salaries plus profit and interest, but the gross value-added includes the depreciation and the above overhead cost in addition to

TABLE 7. INCOME/GROSS VALUE-ADDED RATIO IN 1959

Yamaguchi	57.5%	Saga	82.9%
Toyama	60.3	Akita	83.3
Nagano	62.8	Iwate	85.1
Wakayama	63.5	Kōchi	85.5
Miyazaki	65.5	Kagoshima	86.4
Hiroshima	66.7	Ibaragi	89.5
Chiba	66.9	Shiga	90.7
Kanagawa	67.5	Tokushima	92.5
Shizuoka	67.9	Ōita	92.7
Aichi	68.7	Tottori	97.8
Kumamoto	80.8	Miyagi	100.5
Okayama	80.9	Nara	102.3
Nagasaki	81.6	Yamagata	109.7
Aomori	81.9	Yamanashi	116.9
		Kagawa	119.3

Note: We have omitted prefectures which are between Aichi (68.7%) and Kumamoto (80.8%).

the manufacturing income.

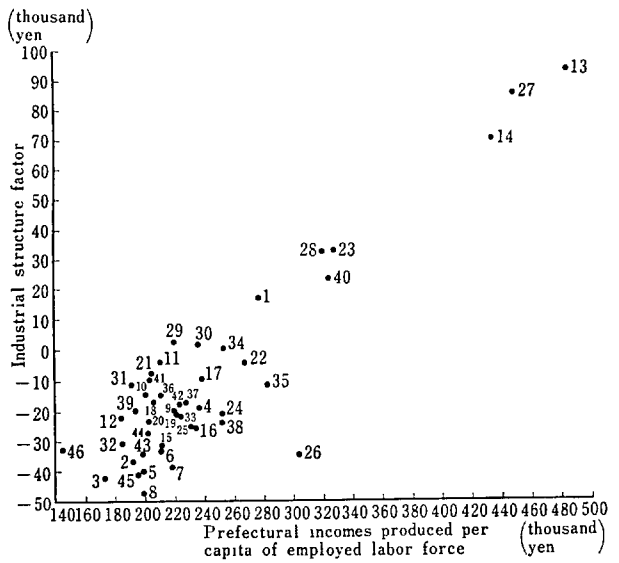
From Table 7, we know that the income gross value-added ratio in manufacturing is very low in the new heavy-industrial prefectures. In 1959, it is 57.5% in Yamaguchi, 60.3% in Toyama, 62.8% in Nagano, 63.5% in Wakayama, 65.5% in Miyazaki, 66.7% in Hiroshima, 66.9% in Chiba, and 67.5% in Kanagawa. Naturally, the rank of this ratio may change from year to year, but Table 7 will inform us of the broad outline of the situation. It is almost an unrecognized fact that some of the gross value-added created inside the prefecture outflows to the head office of the corporations or other industries outside the prefecture, not belonging to the same prefecture. This demonstrates that the dispersion of industries by the development of regional key points or the formation of new industrial districts will not be a sufficient condition for the improvement of the regional income differential. If a part of the profit of the factories is sent out to the head office in Ōsaka or Tōkyō, it does not belong to the prefecture in which the factories are located. Of course, this point should not be overemphasized, and any attempt to industrialize the local district ought not to be assumed as a nonsense. However, it must not be overlooked that, in such a highly capital-intensive industry as petro-chemicals, the proportion of wage and salary bills is very small, and the depreciation, interest and profit, amounting to an enormous portion, flow out of the prefecture. Probably, it is necessary that the location of big industry will entail a simultaneous emergence of complementary industries consisting of, say, parts makers, etc., in order to give the benefit of industrialization to the local district too. It is a very difficult problem to satisfy such a requirement in some prefectures, but, in order for the local industrialization to contribute to the improvement of the regional income differential, the construction of a capital-intensive industry alone as mentioned above will not be sufficient, and the conjunct development of complementary industries in an organic manner will be necessary to distribute the benefit of development more within the prefecture.

The regional differential in terms of income per employed labor force in all industries can

be decomposed into two parts. One is the differences of productivity due to the differences of industrial structure, and in those prefectures whose proportion of the secondary industry is high, the overall productivity will be higher owing to the relatively higher productivity of the secondary industry. Another is a residual part which still remains, even if the differences of industrial structure were assumed as zero. In Fig. 15, this is attempted, as based on the prefectural income statistics and the Census of Population. Since the data is limited, we have to be satisfied with the decomposition into the industrial-structure factor and the other.

In Fig. 15, we have first computed the standardized income per capita of employed labor force, assuming that every prefecture has the same inter-industry employment structure, and deducted this from the "actual" income per capita of employed labor force, and measured the difference along the vertical axis of Fig. 15. Since the dispersion of the actual income per employed labor force among prefectures along the horizontal line amounts to about 360 thousand yen, and that of the industrial-structure factor to about 150 thousand yen, we may roughly guess that about 42% of per labor force income differential among prefectures is accounted for by the industrial-structure factor, and 58% by other factors.

FIG. 15. PREFECTURAL INCOMES PER CAPITA OF EMPLOYED LABOR FORCE AND THE "INDUSTRIAL-STRUCTURE FACTOR", IN 1960



1. Hokkaidō
2. Aomori
3. Iwate
4. Miyagi
5. Akita
6. Yamagata
7. Fukushima
8. Ibaragi
9. Tochigi
10. Gunma
11. Saitama
12. Chiba
13. Tōkyō
14. Kanagawa
15. Niigata
16. Toyama
17. Ishikawa
18. Fukui
19. Yamanashi
20. Nagano
21. Gifu
22. Shizuoka
23. Aichi
24. Miye
25. Shiga
26. Kyōto
27. Ōsaka
28. Hyōgo
29. Nara
30. Wakayama
31. Tottori
32. Shimane
33. Okayama
34. Hiroshima
35. Yamaguchi
36. Tokushima
37. Kagawa
38. Ehime
39. Kōchi
40. Fukuoka
41. Saga
42. Nagasaki
43. Kumamoto
44. Ōita
45. Miyazaki
46. Kagoshima

For instance, the income per employed labor force in the secondary industry is not the same in every prefecture. In 1960, that of Tōkyō was 501,954 yen, and that of Kagoshima was 176,963 yen, a tremendous gap still existing between them. In the tertiary industry, Tōkyō is, 481,485 yen and Kagoshima is 257,284 yen, and in the primary industry, Tōkyō is 210,734 yen and Kagoshima is 86,257 yen. Thus, even in the same industry, we have an enormous differential in productivity. More than that, the proportion of the primary industry is far higher in Kagoshima, so the actual productivity measured in terms of income exhibits a wider difference between the two prefectures than in each industry.

However, the above analysis may be illusory, because it is based on the three-industry

division, and if we have a further detailed breakdown we may have a higher industrial-structure factor. Moreover, if we have a data on the scale of establishment, we can also explore another factor, the size-of-establishment factor. We shall attempt such a type of analysis in section 6.

V. *By-Industry and by-Size Characteristics of Regional Concentration and Differential*

Next is an analysis in relation to the among-prefecture differential or dispersion of selected variables with respect to subgroups of manufacturing and also to size-groups of each industry. We shall continue to use the coefficient of variation, but it measures the regional differential when applied to the value-added productivity, and the degree of concentration or dispersion when applied to the employees or the value-added. In the latter case, analyses will be made as to how the number of employees or the value-added is regionally concentrated or dispersed by subgroups of manufacturing or by size-groups of each industry.

First, the data to be used here is the Census of Manufactures in 1958, but in the detailed breakdowns of prefectural data, further classified into each industry and scales of establishment, we find a lot of concealed figures denoted by x, included in the adjacent figures or total, when in one category only one establishment exists and its figures need to be concealed. Therefore, in our analysis, we have filled up x's by other supplementary scattered data.

Second, we have to bear in mind that 1958 is a depression year. Owing to the depression, in some scales of some industries in some prefectures, we have a minus figure of net value-added, particularly in higher-size establishments. This may give some distortion to our analytical consequences.

Third, we have used the net value-added instead of the gross value-added in this section. In our analyses so far made as to 1950–61, we have converted the net value-added from 1957 on to gross terms, connecting them to the gross value-added for 1950–56, and used them. However, in this section, the net value-added is used as it is.

Fourth, the industrial classification available to us is not detailed. The two-digits classification may not be sufficient for our analytical purpose. The classification of the size of establishments into three divisions is also not satisfactory. The lowest classification, "4–29 employees" will still be rough, because even if its proportion is the same between two prefectures, in terms of employees, one may have a higher proportion of very small establishments, and another may have a higher proportion of relatively large-size establishments. However, the data classified into subgroups of manufacturing, prefectures as well as sizes of establishments, are only available in 1957 and 1958.

Taking into account the above limitations of statistical data, we have computed the coefficient of variation among prefectures in relation to the total size (more than 4 employees), the size of 4–29 employees, the size of 30–299 employees, and the size of more than 300 employees. Table 8 indicates the coefficient of variation of the value-added productivity in the above classifications. This is derived by dividing the standard deviation (from the simple average of net value-added per employee) by that simple average.

Checking the rank of the coefficient of variation in all the sizes, we get the following arrangement. Industries in the higher rank have a larger regional differential in the value-

added productivity compared with those in the lower rank. In the lower rank industries, the regional differential of value-added productivity is smaller.

1. Rubber products
2. Petroleum and coal products
3. Nonferrous metals
4. Pulp and paper
5. Electrical machinery
6. Leather and leather products
7. Iron and steel
8. Ceramics
9. Transportation equipment
10. Instruments and related products
11. Others
12. Chemicals
13. Publishing and printing
14. Metal products
15. Textiles
16. Apparels
17. Food products
18. Machinery
19. Furniture and fixture
20. Lumber and wood products

In general, there are many factors operating on the regional differential of productivity. But, the industry with a higher average value-added productivity may probably have a higher capital intensity, so some regional capital concentration will inevitably take place. Speculating in this way, we have computed the coefficient of rank correlation between the rank of industry in the coefficient of variation of value-added productivity among prefectures in Table 8 and the average net value-added productivity in all prefectures, and got 43.9%. On the other hand, the coefficient of rank correlation between the rank of industry in the coefficient of variation of productivity and the rank of industry in the net value-added per establishment in all prefectures is 58.3%. We compute, further, the proportion of the size of 4–29 employees in the total employees (excluding the size of 1–3 employees), and get the coefficient of rank correlation, 61.7%, between this and the coefficient of variation in Table 8. However, if we exclude chemicals and leathers from twenty industries, the coefficient of rank correlation is raised to 77.4%. From these tentative computations, we have a feeling that the inter-industry differences of the coefficient of variation of the value-added productivity are to a great extent influenced by the proportion of small-medium enterprises in each industry.

The above is a story in relation to the establishments of all sizes, but by each size, we can observe as follows. There is a tendency in every industry that as the size of establishment becomes larger, the coefficient of variation of the net value-added productivity among prefectures becomes higher, indicating the greater regional productivity differential in the higher size. In the size of 300 employees and more, there are no establishments at all in some industries of some prefectures. Incidentally, the figures in brackets are computed, leaving out of account the empty part sometimes emerging in the establishments of the highest size. In other words, when we have the figures of only twenty prefectures in the total forty-six prefectures, the bracketed figure is the coefficient of variation among the twenty prefctures as based on the simple arithmetical average of net value-added productivity of the twenty prefectures. On the other hand, the figures without brackets are computed on the assumption that the productivity of prefectures without figures is zero but is included in the computation of the coefficient of variation. Therefore, in the latter computation, the larger the number of empty box in the statistical table, the higher the coefficient of regional productivity differential tends to be. One of the reasons why the coefficient of variation in the latter concept becomes higher lies in this respect.

Those industries, in which the coefficients of variation among prefectures of the net

TABLE 8. COEFFICIENT OF VARIATION OF NET VALUE-ADDED PRODUCTIVITY AMONG PREFECTURES IN SUBGROUPS OF MANUFACTURING, CROSS-CLASSIFIED BY SIZE OF ESTABLISHMENT, 1958

	All sizes (excl. 1–3 employees)	4–29 employees	30–299 employees	300 employees and more
Food products	0.2725	0.1348	0.3447	1.2516(0.7116)
Textiles	0.3051	0.3279	0.3560	0.5490(0.4653)
Apparels	0.2879	0.3547(0.3184)	0.4832(0.3912)	2.1757(0.4965)
Lumber	0.1903	0.1541	0.3153	2.3685(0.3867)
Furniture and fixture	0.2238	0.2093	1.1440(1.0996)	3.5212(1.1534)
Pulp and paper	0.5913	0.3208	0.6867(0.6380)	1.0806(0.7128)
Publishing and printing	0.3787	0.2537	0.2899	1.1623(0.3526)
Chemicals	0.4243	0.3414	0.6065(0.5553)	0.8124(0.5128)
Petroleum and coal products	0.8193	0.5398(0.5132)	1.0110(0.7335)	2.8092(0.9659)
Rubber products	0.8826(0.6852)	0.8921(0.4586)	0.8923(0.4589)	1.7178(0.7949)
Leather and leather products	0.5793(0.4685)	0.6239(0.5182)	1.0570(0.4440)	3.6176(0.4744)
Ceramics	0.5306	0.3060	0.4133	0.8712(0.5479)
Iron and steel	0.5738	0.3639	0.5947(0.5694)	1.1569(0.5672)
Nonferrous metals	0.5999(0.5208)	0.6239(0.3843)	0.8276(0.5310)	1.0988(0.6630)
Metal goods	0.3407	0.1884	0.3909	1.9309(0.8029)
Machinery, exc. electrical	0.2687	0.1838	0.3499	0.6948(0.3098)
Electrical machinery	0.5892(0.5372)	0.4724(0.3787)	0.6096(0.4037)	0.9966(0.4618)
Transp. equipment	0.5074	0.2356	0.4022	1.1216(0.4766)
Instruments and related products	0.4842(0.4252)	0.3913(0.3209)	1.7790(1.5032)	2.0135(0.3142)
Others	0.4305	0.3001	0.5566(0.5029)	1.7225(0.5418)

Source: Ministry of International Trade and Industry, *Census of Manufactures*, 1958.
The concealed figures x's were estimated by the writer.

Notes: 1) "Total" excludes "1–3 employees".

2) In some industries, the establishment is non-existent in the upper size. In such a case, the coefficient of variation was computed under the assumption that the productivity is zero, and in the computation of the average it was also included as a sample. Figures in brackets are computation, taking them out of account.

3) Weapons industry is omitted, for the number of sample is extremely small.

value-added productivity in the size of 300 employees and more are extremely high, are not always the industries centering upon the big enterprises. As is indicated in Table 8, the industries, such as furniture and fixture, lumber and wood products, apparels, and leathers are of small-enterprise type. Yet, they indicate a considerably high coefficient of variation in the highest size, because of the fact that the big enterprise is unexceptional in these industries. If there are a fairly lot of prefectures with zero employee and net value-added except for some prefectures, the high coefficient of variation will necessarily be computed as a result of the latter calculation.

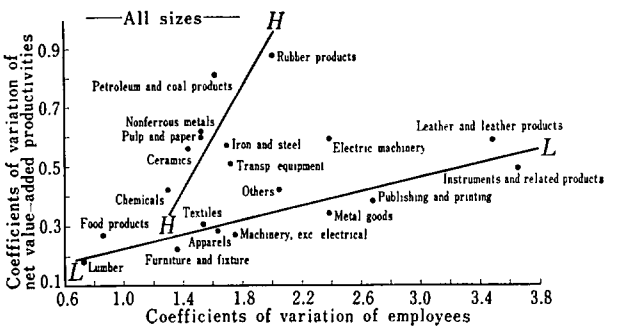
Table 9 computes the coefficient of variation among prefectures in relation to the number of employees. In the case of the net value-added productivity, it represents an indicator of the regional differential, but in the case of the number of employees, it stands for an indicator of regional concentration or dispersion.

TABLE 9. COEFFICIENT OF VARIATION OF THE NUMBER OF EMPLOYEES AMONG PREFECTURES IN SUBGROUPS OF MANUFACTURING, CROSS-CLASSIFIED BY SIZE OF ESTABLISHMENT, 1958

	All sizes (excl. 1–3 employees)	4–29 employees	30–299 employees	300 employees and more
Food products	0.8777	0.6641	1.0590	1.7972(1.2179)
Textiles	1.5388	1.5841	1.5262	1.6805(1.6046)
Apparels	1.6729	1.8491(1.8235)	1.5100(1.4381)	2.7669(0.9452)
Lumber and wood products	0.7489	0.5723	1.0700	3.1064(0.9261)
Furniture and fixture	1.3714	1.2687	1.6983(1.6491)	2.3250(0.3693)
Pulp and paper	1.5295	1.7158	1.6585(1.6087)	1.6327(1.2452)
Publishing and printing	2.7047	2.1301	2.7349	3.5860(2.3728)
Chemicals	1.3109	1.6526	1.8881(1.8352)	1.2462(0.9710)
Petroleum and coal products	1.6325	1.6648(1.6839)	1.8463(1.5417)	2.4052(0.6925)
Rubber products	2.0301(1.7977)	3.1619(2.5371)	2.5863(2.0456)	2.0251(1.0528)
Leather and leather products	3.5179(3.3492)	3.5850(3.4138)	3.1683(2.2916)	4.7082(1.0113)
Ceramics	1.4022	1.3308	1.5863	1.5763(1.2561)
Iron and steel	1.7239	1.8580	2.0486(2.0214)	2.1728(1.4946)
Nonferrous metals	1.5332(1.4603)	2.7171(2.4381)	2.5703(2.1891)	1.1690(0.7375)
Metal products	2.4170	2.5680	2.3434	2.3733(1.1444)
Machinery	1.7732	1.9424	1.9329	1.5900(1.2683)
Electrical machinery	2.3981(2.3361)	3.4189(3.2956)	2.9369(2.6761)	2.1904(1.5904)
Transp. equipment	1.7352	2.1804	1.9020	1.8769(1.2076)
Instruments and related products	3.6881(3.6012)	3.3874(3.3080)	3.3369(2.9154)	4.3341(1.8173)
Others	2.0629	1.9310	2.2492(2.1899)	2.3826(1.0865)

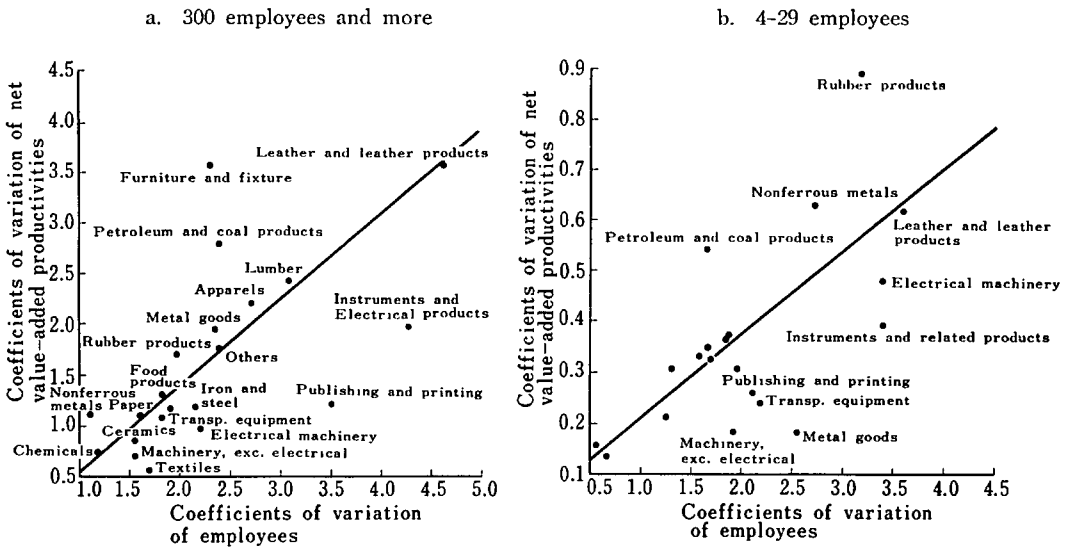
We may not always have a close correlation between the two coefficients of variation of the net value-added productivity, on the one hand, and the number of employees, on the other. Fig. 16, however, presents an interesting consequence, when both coefficients of variation are correlated as to all sizes excluding the size of 1–3 employees. The two lines (*H* and *L*) are

FIG. 16. COEFFICIENTS OF VARIATION OF NET VALUE-ADDED PRODUCTIVITIES AND EMPLOYEES AMONG PREFECTURES, 1958



split, and heavy industries of the capital-intensive type cluster around the H line, while light and heavy industries of the relatively labor-intensive type closely scatter around the L line. For the former, there are the rubber products, petroleum and coal products, iron and steel, nonferrous metals, paper and pulp, transportation equipments, ceramic, and chemicals. For the latter, we can mention the food products, lumber and wood products, furniture and fixture, textiles, apparels, leathers, printing and publishing, and other light industry, plus the metal goods, machinery, instruments and related product. The electrical machinery industry is located in between the two lines. From these observations, we can derive an important conclusion that the regional concentration of employees in relatively capital-intensive industries will bring about much larger regional differential of net value-added productivity among prefectures than in the case of the regional concentration of relatively labor-intensive industries.

FIG. 17. COEFFICIENTS OF VARIATION OF NET VALUE-ADDED PRODUCTIVITIES AND EMPLOYEES AMONG PREFECTURES, BY SIZE OF ESTABLISHMENT, 1958



However, if we examine it further by size of establishment, the conclusion will be less obvious as is shown in Fig. 17. Fig. 17 takes up the sizes of 300 employees and over as well as 4-29 employees. In the size of 300 employees and over, the sixteen industries are clustered around the free-hand line, except for furniture and fixture, petroleum and coal products and instruments and related products. However, in the size of 4-29 employees, the dispersion becomes very irregular.

VI. *Factors Affecting the Regional Differential of Value-Added Productivity in Manufacturing*

We are going to use the Census of Manufactures of 1958 (the prefectural data classified by industry and size) for another purpose. First, we compute the "standardized" net value-

added productivity which are derived on an assumed condition as if, in every prefecture, the by-size composition of employees in each industry of manufacturing were the same as the by-size average employment structure in each industry of all prefectures (including Hokkaidō). In other words, this is a productivity which has abstracted or taken away from the actual productivity the influences arising from the difference of the by-size employment structures among prefectures. The difference between this standardized productivity and the actual productivity in each industry and prefecture indicates a part of regional productivity difference, which is ascribed to the prefectural difference of the by-size employment structures, explaining to what extent the actual regional differences of net value-added productivity is caused by the regional differences of the relative by-size employment composition. In the following, $\bar{Y}_{ij}$ ($i=1, \ldots, 20$, indicating the subgroups of manufacturing, and $j=1, \ldots, 46$, indicating the prefectures) denotes the *standardized* net value-added productivity in various industries and in various prefectures, and Y_{ij} (the productivity in manufacturing as a whole is designated simply by Y_i) denotes the *actual* net value-added productivity by industry and by prefecture.

We are going to consider the further standardization of the above standardized $\bar{Y}_{ij}$ in each industry, by the relative industrial composition of employees in all prefectures. In other words, actually the industrial structure in terms of employment differs from prefecture to prefecture, but what we are going to do is to standardize it by the uniform or common industrial structure in 46 prefectures as a whole in terms of employees. Denoting by $\bar{W}_i$ the relative industrial composition of employees in all prefectures, and by W_{ij} the actual relative industrial composition of employees in each prefecture, we find that the net value-added productivity in manufacturing industry as a whole, which is standardized only as concerns the " by-size " employment structure of each prefecture, is

$$\sum_{i=1}^{20} W_{ij}\bar{Y}_{ij}$$

and the net value-added productivity, which is standardized both as concerns the "by-size" and the "industrial" employment structures, is

$$\sum_{i=1}^{20} \bar{W}_i\bar{Y}_{ij}.$$

If we simplify the denotations as follows,

$$\bar{Y}_j=\sum_{i=1}^{20} W_{ij}\bar{Y}_{ij}\,;\ \bar{\bar{Y}}_j=\sum_{i=1}^{20} \bar{W}_i\bar{Y}_{ij}$$

we have two kinds of standardized net value-added productivities. From the combination of the two and the actual productivity, we can derive the "industrial-structure factor" as $(\bar{Y}_j-\bar{\bar{Y}}_j)$ and the "size-structure factor" as $(Y_j-\bar{Y}_j)$.

$\bar{\bar{Y}}_j$ is already standardized not only in the differences of the by-size structure but also of the industrial structure in terms of employment, so the prefectural differences of $\bar{\bar{Y}}_j$ are attributed neither to the "industrial-structure factor" nor to the "size-structure factor". Tentatively, we consider it here as being due to the "residual-regional factor", which may be highly dependent on the benefit of the "external economy" accompanied by the regional industrialization or the enhancement of regional industrial level.

However, we must add hastily here that the above procedure will not elucidate what proportions of the "level" of the value-added productivity in the "specific" prefecture consist of the "industrial-structure factor", the "size-structure factor" and the "residual-regional factor". For instance, some industries in some prefectures were assume to have the same by-size employment structure as in all prefectures. Then $Y_{ij}=\bar{Y}_{ij}$ would prevail, and the "size-structure factor" would be zero in our calculation. But this does not point toward the non-existence of the "size-structure factor" in that prefecture. It merely indicates what percentage of the

regional "differential" in some industries among prefectures is dependent on the difference of industrial structure, size structure, and so on. What we are concerned here is the analysis of factors in relation to the absolute "differences" of productivity among prefectures, and not of that to the absolute "magnitude" of productivity in each prefecture.

Therefore, we shall try to make a simple regression analysis in order to make clear the causes of the regional "differences" of productivity. As concerns with each industry, we have fitted a linear function between the computed "size-structure factor" in each prefecture and the actual value-added productivity as follows:

$$(Y_{ij}-\bar{Y}_{ij})=a+b(Y_{ij}).$$

In some cases, this was computed after excluding extremely scattered prefectures. The year 1958 was a year of depression, and we have a case that in some sizes of establishments, industries and prefectures, the value-added becomes of minus value. Therefore, we have decided to omit some of the fantastic values from our regression analysis.

The coefficient of determination is not always high in Table 10. However, the regression coefficient is prevailingly for 20-40%, if we omit equations in which the coefficient of determination is extremely low (less than 0.12). Moreover, the regression coefficient "b" is always positive, and the intercept "a" is unanimously negative. It is thus clear that the "size-structure factor" makes a positive contribution to the regional differences of productivity to the extent

TABLE 10. SIZE-STRUCTURE FACTOR AND INDUSTRIAL-STRUCTURE FACTOR

		(thousand yen)	
Equations explaining the "size-structure factor"	Manufacturing (excl. Chiba)	$y=-80.23+0.2072x$	$R^2=0.5239$
	„ (excl. Chiba, Tōkyō, Ōsaka, Kyōto)	$y=-91.94+0.2468x$	$R^2=0.6933$
	Food products (excl. Kyōto, Miye, Kumamoto)	$y=-97.71+0.2136x$	$R^2=0.3465$
	Textiles (excl. Kyōto, Akita, Kagoshima)	$y=-48.26+0.2134x$	$R^2=0.3102$
	Lumber and wood products (excl. Miye, Nara)	$y=-41.71+0.1388x$	$R^2=0.1294$
	Furniture and fixture (excl. Tōkyō, Hyōgo, Fukushima)	$y=-21.93+0.0860x$	$R^2=0.0825$
	Pulp and paper (all prefectures)	$y=-210.37+0.5160x$	$R^2=0.6174$
	Publishing and Printing (all prefectures)	$y=-202.47+0.3836x$	$R^2=0.4804$
	Chemicals (excl. Saitama, Saga, Tokushima)	$y=-127.52+0.1418x$	$R^2=0.1188$
	Rubber products (excl. Chiba and Niigata)	$y=-83.88+0.1893x$	$R^2=0.3291$
	Leather and leather products (excl. Hiroshima)	$y=-18.49+0.0309x$	$R^2=0.0131$
	Ceramics (excl. Hokkaidō)	$y=-158.09+0.3876x$	$R^2=0.5628$
	Iron and Steel (excl. Miyazaki, Aomori, Ōita, Shiga)	$y=-180.61+.03287x$	$R^2=0.3895$
	Nonferrous metals (all prefectures)	$y=-169.60+0.2820x$	$R^2=0.2413$
	Machinery (all prefectures)	$y=-142.84+0.3518x$	$R^2=0.5173$
	Electr machinery (excl Nara, Wakayama, Kōchi, Kumamoto)	$y=-180.04+0.3513x$	$R^2=0.4450$
	Transp. exuipments (excl. Shizuoka. Ōita, Ehime, Shiga, Nara)	$y=-218.13+0.3918x$	$R^2=0.5137$
Equations explaining the "industrial-structure factor"	Manufacturing (all prefectures)	$y=-130.59+0.3266x$	$R^2=0.4976$
	„ (Kanagawa, Fukuoka, Hyōgo, Tōkyō, Osaka, Hokkaidō, Miye, Shizuoka, Kyōto, Ōita, Wakayama, Kagawa, Kōchi, Gifu, Ishikawa, Fukui, Nara, Shiga, Saitama, Aichi)	$y=-197.67+0.4111x$	$R^2=0.8341$
	„ (other prefectures)	$y=-157.18+0.4682x$	$R^2=0.7735$

that the regressive coefficients are 0.2–0.4.

In manufacturing as a whole, coefficient of the "size-structure factor" is 0.2072–0.2468 and that of the "industrial-structure facture factor" is 0.3266–0.4682. Consequently, the total of the two is 0.5338–0.7150, and the "residual-regional factor" will be 0.4662–0.2850, which will be derived by deducting 0.5338–0.7150 from unity. However, it is erroneous to give these coefficients an absolute meaning. The size classification is only of three breakdowns, and the number of industries is only of twenty breakdowns. Therefore, the total of the two factors should far exceed 0.5–0.7.

Nevertheless, these computations will give us some suggestions. In Fig. 18, which explains the "industrial-structure factor" as compared with the net value-added productivity, we have, along the lower line, the big city areas, the industrialized regions, and the prefectures in which they have established already important light industries, on the one hand. As such, we can mention Tōkyō, Ōsaka, Kanagawa, Hyōgo, Miye, Shizuoka, Kyōto, Wakayama, Aichi, Fukui, etc. On the other hand, along the upper line in Fig. 18, the underdeveloped prefectures cluster together particularly in the region of lower value-added productivity, although some newly developed heavy-industry prefectures are involved. This gives us a suggestion. Probably, the prefectures belonging to the lower line are supposed to have a higher "residual-regional factor", for in Fig. 19 which explains the "size-structure factor", almost all prefectures except for Tōkyō, Ōsaka, Kyōto and Chiba are along the one line, and therefore the residual part should be necessarily higher in the prefectures in the lower line than in the higher. If so, those prefectures along the lower line should logically have a higher external economy which is provided by the development of complementary industries and the expansion of the consumer's as well as producer's market. This is so, provided that the major part of the "residual-regional factor" will consist of the benefit from the external economy.

The above is an analysis developed only in relation to the depression year, 1958, so it

FIG. 18. REGIONAL DIFFERENTIAL OF NET VALUE-ADDED PRODUCTIVITIES IN MANUFACTURING AND THE INDUSTRIAL-STRUCTURE FACTOR

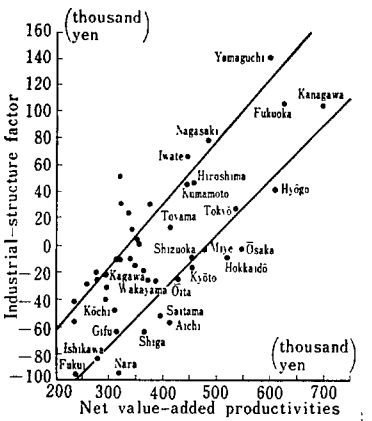
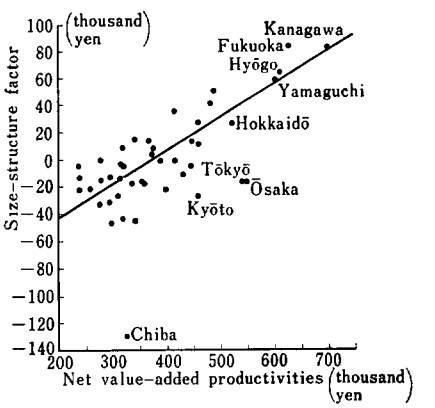


FIG. 19. REGIONAL DIFFERENTIAL OF NET VALUE-ADDED PRODUCTIVITIES IN MANUFACTURING AND THE SIZE-STRUCTURE FACTOR 1958

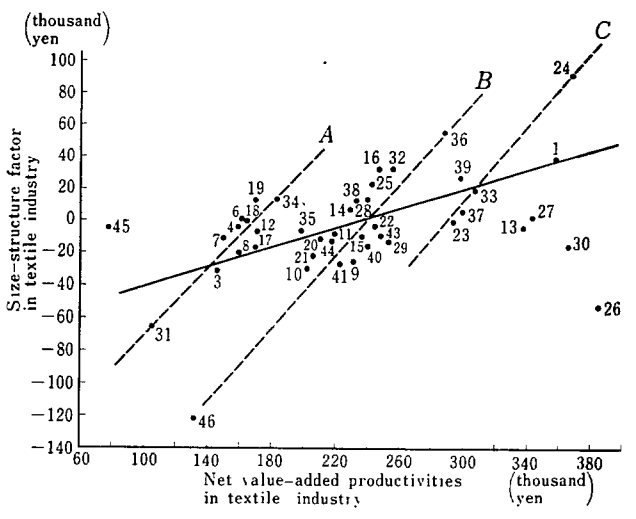


should be accepted only after similar analyses are conducted in relation to other years. Our analysis, thus, comes to the close, leaving some obscurity behind. However, it may be an analysis worth-while to be made as a preliminary analysis, yet it is our first step to explore the factors causing the regional productivity differential.

In order to add a more detailed concrete analysis, we shall take up here the textile industry. In this industry, there are only three prefectures, Aomori, Akita, and Nagasaki, which have no establishment in the size of over 300 employees. Therefore, we are trying to conduct a special-type analysis as to the "size-structure factor" in relation to the remaining 43 prefectures. Measuring on the vertical axis the "size-structure factor" in textile industry, and on the horizontal axis, the net value-added productivity, we have constructed Fig. 20. A casual glance at the chart will give us an impression of poor correlation. But a free-hand line drawn for all the scattered points will suggest that the "size-structure factor" contributed by about 20–30% to the regional dispersion of the net value-added productivity among prefectures (this free-hand line is different from the regression derived from an equation in Table 10, for the latter's coefficient of determination 0.3102 does not give us a confidence that the free-hand is worthier than the one way fitting from x to y). However, a careful observation will elucidate the following interesting points. All the scattered points can be divided, by and large, into three subgroups: A, B, and C. Each of these subgroups can be further examined in Table 11. The pattern A mainly consists of prefectures in which the silk-reeling industry occupies a major part in the textile industry. Among the pattern A, the pattern A-1 has a predominant proportion of silk-reeling industry in the shipments of the textile industry. However, even among the pattern A-2, the proportion of silk-reeling is fairly high. Therefore, among eleven prefectures, the seven prefectures have a very close connection with the silk-reeling industry.

The peculiarity of the pattern B lies in the high proportion of the yarn-and-thread industry. Particularly, the patterns B-1 and B-2 are so, and among twenty-one prefectures belonging to

FIG. 20. PREFECTURAL DIFFERENCES OF THE SIZE-STRUCTURE FACTOR IN TEXTILE INDUSTRY



1. Hokkaidō
3. Iwate
4. Miyagi
6. Yamagata
7. Fukushima
8. Ibaragi
9. Tochigi
10. Gunma
11. Saitama
12. Chiba
13. Tōkyō
14. Kanagawa
15. Niigata
16. Toyama
17. Ishikawa
18. Fukui
19. Yamanashi
20. Nagano
21. Gifu
22. Shizuoka
23. Aichi
24. Miye
25. Shiga
26. Kyōto
27. Ōsaka
28. Hyōgo
29. Nara
30. Wakayawa
31. Tottori
32. Shimane
33. Okayama
34. Hiroshima
35. Yamaguchi
36. Tokushima
37. Kagawa
38. Ehime
39. Kōchi
40. Fukuoka
41. Saga
43. Kumamoto
44. Ōita
45. Miyazaki
46. Kagoshima

TABLE 11. ANALYSIS OF FIG. 20

The Pattern A

1. Centered on silk-reeling industry
   Iwate (45.1%), Miyagi (49.9%), Ibaragi (59.7%), Yamanashi (41.5%) Fukushima (41.6%)
2. Others
   Yamagata (silk-reeling 26.4%, weaving 55.8%), Chiba (yarn and thread 68.5%), Ishikawa (weaving 41.1%, yarn and thread 38.5%), Fukui (weaving 61.8%, dyeing 17.3%), Tottori (yarn and thread 67.2%, silk-reeling 29.3%), Hiroshima (yarn and thread 37.0%, weaving 32.3%).

The Pattern B

1. Centered on yarn and thread industry
   Kanagawa (42.5%), Toyama (69.6%), Gifu (73.5%), Shizuoka (44.8%), Shiga (46.6%), Hyōgo (54.8%), Shimane (55.7%), Tokushima (44.3%), Ōita (64.5%).
2. Yarn and thread mixed with others
   Tochigi (yarn and thread 23.1%, weaving 33.2%), Saitama (yarn and thread 23.5%, weaving 32.7%), Nagano (yarn and thread 33.6%, silk-reeling 56.5%), Ehime (yarn and thread 38.0%, weaving 48.8%), Kumamoto (yarn and thread 45.7%, silk-reeling 43.4%).
3. Yarn and thread, but with small proportions
   Gunma (yarn and thread 14.7%, weaving 40.2%, silk-reeling 31.3%), Niigata (yarn and thread 12.9%, weaving 48. 4%, knit fabric 14.8%), Nara (yarn and thread 28.7%, knit fabric 48.6%), Yamaguchi (yarn and thread 2.4%, rope and net 56.1%), Saga (obscured by concealment, x), Fukuoka (yarn and thread 19.7%, weaving 37.6%, other textiles 27.7%), Kagoshima (yarn and thread 10.8%, weaving 33.7%, silk-reeling 20.4%).

The Pattern C and Others

1. Shipments of yarn and thread high, by and large, with their high proportions (Pattern C)
   Aichi (yarn and thread 39.1%, weaving 39.2%), Miye (85.2%), Okayama (59.2%), [Kagawa (58.7%), Kōchi (58.5%) — shipments are small]
2. Dispersed pattern
   Hokkaidō (yarn and thread 27.5%, rope and net 40.6%), Miyazaki (silk-reeling 69.9%), Kyōto (weaving 33.5%, dyeing 31.7%)
3. Diversification of products pattern (high in shipments too)
   Tōkyō (knitted fabrics 38.8%, yarn and thread 17.1%, weaving 15.8%, dyeing 15.3%), Ōsaka (yarn and thread 40.6%, weaving 22.4%, dyeing 18.5%, knitted fabrics 12.5%), Wakayama (dyeing 33.8%, knitted fabrics 29.1%, yarn and thread 18.2% weaving 15.8%).

B, we can say fourteen prefectures are perfectly of the yarn-and-thread industry pattern.

On the other hand, the prefectures: Aichi, Miye and Okayama have a particularly high absolute amount of shipments of the yarn-and-thread industry. In the pattern *A*-2, we have prefectures in which the proportion of the yarn-and-thread industry is very high, but their absolute amount of shipments is low. The pattern *C*, however, involves prefectures in which the absolute amount of shipments of them is also particularly high. To the dispersed pattern belong Miyazaki, in which the proportion of the silk-reeling occupies about 70% (the highest), and Kyōto, which is very famous in the Nishijin weaving industry (which produces the highest quality in woven fabrics and whose value-added productivity is the highest). The former scatters to the leftward extreme and the latter scatters to the rightside extreme. Hokkaidō also scatters far from any of the three subgroups, but it is characterized by the shipments of nets and ropes amounting to about 40%.

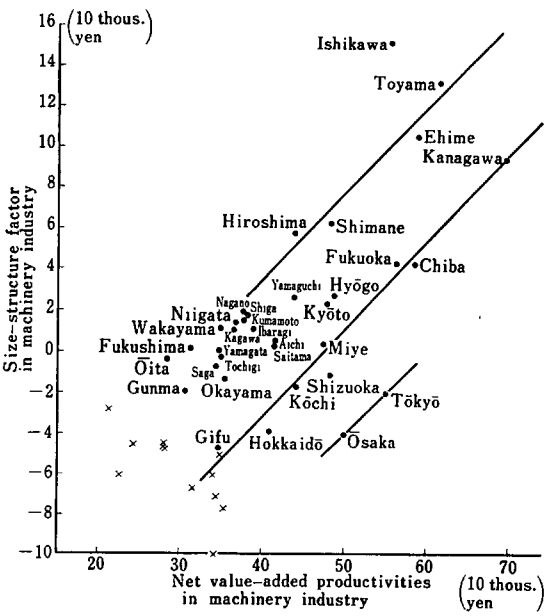
The most interesting are Tōkyō, Ōsaka, and Wakayama, and they are characterized by an enormous amount of shipments as well as by the extremely diversified production of various

textiles.

When the straight lines are fitted to each of the patterns, *A*, *B*, and *C*, notable results come up that within each particular subgroup the "size-structure factor" plays about a 100% role in the rise of the net value-added productivity. Thus, the more the industry is broken down in detail, the higher the role of the "size-structure factor" would be, as an explanatory variable of the regional productivity differential.

Another special analysis will be additionally conducted in Fig. 21 with respect to the machinery industry (in narrower sense, excluding electrical machinery, transportation equipments, etc.), by a graphical procedure. In Fig. 21, with signs "×" are the prefectures in which there are no establishments with over 300 employees. Therefore, we have estimated a "potential" net value-added productivity in that size by making it proportional to the by-size slope of the average net value-added productivity of the same industry in all prefectures. After this is done, a standardized productivity was computed in that prefecture by applying the by-size employment composition in all prefectures. The difference between the actual and the standardized productivities thus computed is the "size-structure factor" we have already referred to. Therefore, the "size-structure factor" in the prefectures with sign "×" may involve some errors, and we have omitted to mention names of those prefectures in Fig. 21.

FIG. 21. PREFECTURAL DIFFERENCES OF THE SIZE-STRUCTURE FACTOR IN MACHINERY INDUSTRY



The derived observations are as follows: Drawing the three rightward rising lines by free-hand, we find that Tōkyō and Ōsaka are along the lowest line. In other words, compared with productivity, the "size-structure factor" is relatively low. This may be due to two reasons. 1) As far as the machinery industry is concerned, the proportion of the lower sizes is unexpectedly high in Tōkyō and Ōsaka, and this reduces the "size-structure factor" of them. 2)

However, when the productivities of the same size are compared, Tōkyō and Ōsaka are relatively higher in the lower sizes.

Table 12 makes this point clear. Among thirteen prefectures, the proportion of employees in the size of 4–29 employees is 32.6% in Tōkyō and 31.2% in Ōsaka, surpassing those of other industrial prefectures. However, the net value-added productivity in the size of 4–29 employees is 381 thousand yen in Tōkyō and 344 thousand yen in Ōsaka, far exceeding Aichi, Chiba, Yamaguchi, Hiroshima, Toyama and Ishikawa, which are in the range of 230–280 thousand yen. Compared with 195 thousand yen of Kagoshima, they have productivities twice as high. The fact we have so wide differential in the same size and in the same industry may be partly due to the higher composition of the upper part in the intrastructure of the size of 4–29 employees in Tōkyō and Ōsaka. But it may be further dependent upon the greater benefit from the external economy compared with other prefectures. Those small enterprises, which act as parts makers and are located in the neighborhood of a big assembly factory, will benefit more than those in other prefectures in increasing their shipments and production by specializing themselves in small number of products and by increasing their productivities through mass production. Tōkyō and Ōsaka occupied 36.2% of the total employees and 39.9% of the total shipments of machinery industry in the country as a whole in 1958. It is to be noted that, even if the productive activity is highly concentrated to big cities, the proportion of small-medium enterprises is much higher than that of large enterprises in big cities. The number of employees in Tōkyō and Ōsaka in the size of over 300 employees is 23.7% of the entire country, but it is 40.7% in both of the sizes of 4–29 and 30–299 employees.

TABLE 12. INTER-PREFECTURAL COMPARISON OF EMPLOYMENT STRUCTURE AND PRODUCTIVITY IN MACHINERY INDUSTRY IN 1958

	By-size employment composition (%)				By-size net value-added productivity (thousand yen)			
	Total	4–29 employees	30–299 employees	300 employees and more	Total	4–29 employees	30–299 employees	300 employees and more
Tōkyō	100	32.6	46.1	21.2	552	381	565	785
Ōsaka	100	31.2	55.5	13.3	501	344	522	784
Kanagawa	100	17.4	31.9	50.7	700	340	610	880
Aichi	100	29.3	39.5	31.2	416	282	412	547
Chiba	100	31.7	32.9	35.4	587	260	450	1008
Hyōgo	100	19.7	38.5	41.8	488	317	488	569
Yamaguchi	100	22.5	43.3	34.2	439	287	352	649
Hiroshima	100	23.5	32.8	43.7	441	224	334	638
Shimane	100	27.8	37.1	35.1	484	175	246	981
Ehime	100	22.9	37.3	39.7	592	221	305	1077
Toyama	100	21.8	32.2	46.0	619	233	348	992
Ishikawa	100	17.2	24.4	58.4	560	232	310	762
Kagoshima	100	59.4	40.6	0	227	195	271	—

In Fig. 21, Ishikawa is located in the highest place, and this may be due to the existence of the Komatsu Seisakusho (Komatsu Manufacturing Co. Ltd.), which has one of the biggest factories of the construction machinery there. In Ishikawa prefecture, the proportion of the

construction and mining machineries in the shipments of the general machineries amounts to 39.7% in 1958. Further, the composition of employees in the size of over 300 employees in the same prefecture is 58.4%, the top in Japan. Toyama is also scattered near Ishikawa in Fig. 21, and this may be due to the existence of the Fujikoshi Kōzai Kōgyo (Fujikoshi Steel Industry Co. Ltd.), which is devoted to the production of bearing and machine tools. In Toyama prefecture, the proportion of shipments of the "other machineries and parts" amounts to 73.5%, owing to Fujikoshi's existence. In such a way, a big factory in the local prefecture will strongly affect the "size-structure factor" and the productivity there. On the other hand, in the big cities, the small-medium enterprises of machinery industry grow in clusters in the close network of organic and hierarchical subcontracting systems. These contrasts in the local and central machinery factories present a peculiarity in the location of machinery industry.

In Fig. 21, if we take out of account Ishikawa, Tōkyō and Ōsaka and prefectures with signs × (none in the size of over 300 employees), we may have the two lines fitted by free-hand. Scattered along the lower line, we find, are already industrialized prefectures (Kanagawa, Hyōgo, Fukuoka, Kyōto, etc.) or their adjacent industrial prefectures (Chiba, Miye, Shizuoka, Gifu, etc.). We find, round the upper line, however, Ishikawa, Toyama, Ehime, Shimane, Hiroshima, Nagano, Niigata, Fukushima, etc. Some of these are late-industrialized prefectures, and others are non-industrial ones. It is interesting to see the existence of a rather inverse relation in the machinery industry between the "size-structure factor" and the economic levels of various prefectures.

VII. *Conclusion*

The major conclusions derived from our analysis are as follows:

1) Although it is generally argued that the regional differentials of per capita income and productivity has expanded in the process of rapid economic growth, we cannot get any statistical substantiation supporting it.

2) When dividing the entire country into two, the industrialized prefectures and the non-industrialized ones, the regional differential has widened between the two groups, but within each group, we see a tendency for the differential to be reduced. The two counter-vailing tendencies of the aggravation and equalization having been offset, the overall indicator shows the levelling-off trend.

3) Although the indicator for the productivity differential in manufacturing tends to level off, it has a rather decreasing tendency when we take up heavy and light industries separately. This is because the increasing regional differential due to the rise of the proportion of heavy industry with higher differential might have offset the differential-reducing tendency of in each of the heavy and light industries, respectively. In this sense, the heavy industrialization has been differential-accelerating by itself, when the intrinsic trend of the productivity differential of light and heavy industries respectively is separated. Therefore, it might be said that the future tendency of the regional productivity differential is highly dependent on the pace of heavy industrialization.

4) When all industries are broken down into the primary, secondary, and tertiary industries, and their proportions — be they in terms of labor force or income — are correlated with per capita income levels, we can get so obvious a similarity or empirical law among prefectures

as can be derived usually from international comparison. This holds true not only in the industrial composition but also in the comparative productivities of the three industries. What is different from the case of international comparison is that the labor force proportion of the secondary industry is higher in the higher per capita income prefecture, and this correlation is very excellent, despite the indefinite conclusion in the case of international comparison. We have also a positive correlation between the manufacturing value-added productivity and the heavy-industry ratio.

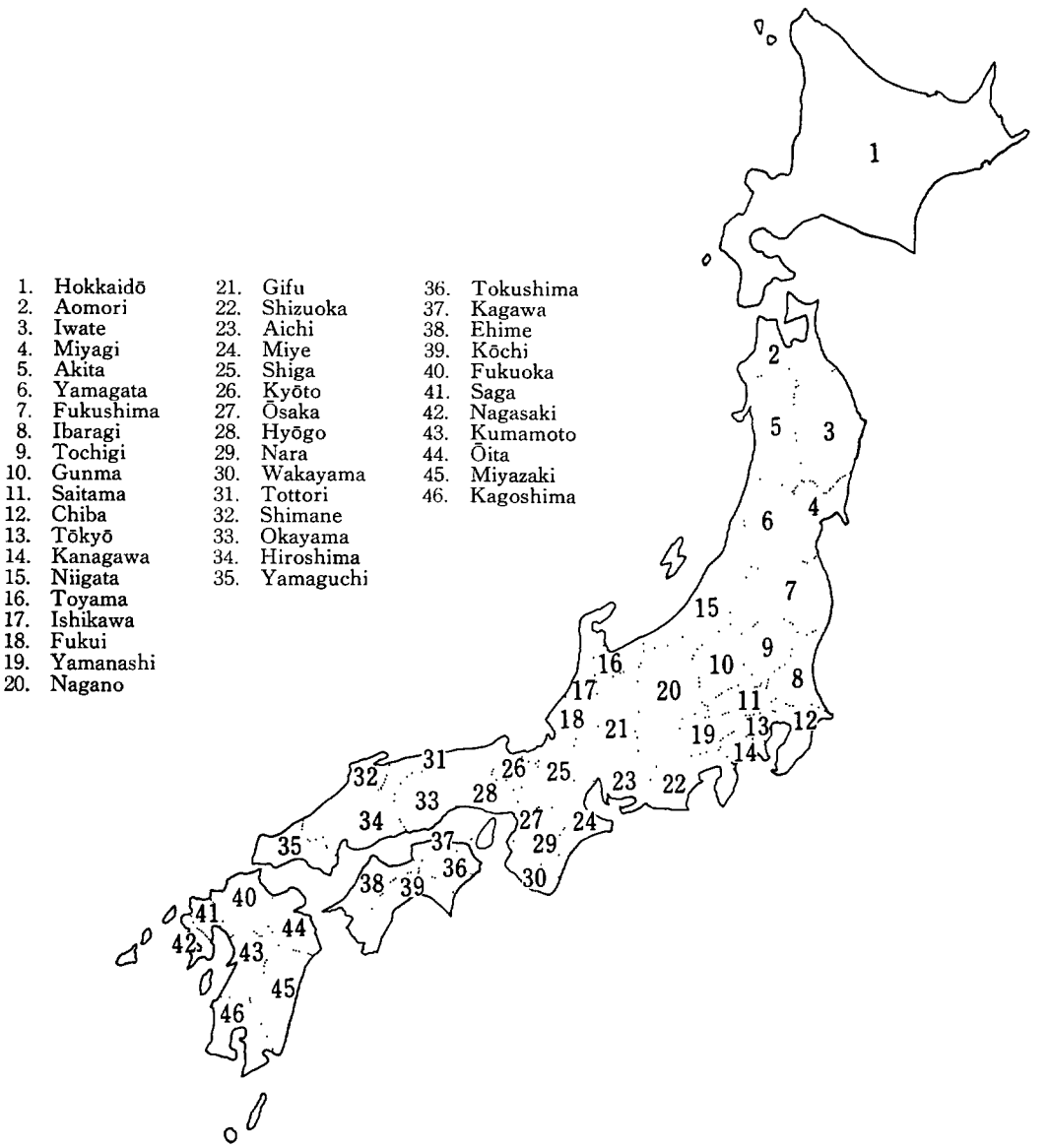
5) In industrial prefectures in the neighborhood of big cities or in newly developed heavy-industrial prefectures, the proportion of income, which will belong to their prefectures in the total value-added by manufactures, is sometimes very low. In the prefectures in which the income gross value-added ratio is very low, the profit is sent to the head office in Tōkyō or Ōsaka and the interest or other overhead charges tend to flow outside the prefecture. This seems to be a blind spot in the current argument for the regional development.

6) The regional productivity differential may emerge not only from the productivity differential in each industry but also from the regional differences of industrial structure. As based on the prefectural income statistics and the Census of Population, we have tried to analyze the "industrial-structure factor" in the latter sense. We are further going to analyze the "industrial-structure factor", the "size-structure factor", and the "residual-regional factor" by applying the standardization method, as based upon the Census of Manufactures. Our result will be subject to limitations arising from the statistical weakness, but about 40% of the prefectural productivity differential is explained by the "industrial-structure factor" and about its 25% by the "size-structure factor" and the residual can be judged as accruing from the benefit of the external economy, etc. In general, the "residual-regional factor" seems to occupy a relatively higher proportion in Tōkyō, Ōsaka, Kyōto, Aichi, Kanagawa, etc., around which or inside which the complementary industries and the wide consumer or producer market develop to the full, benefitting from advantages of the external economy.

7) As concerns the "size-structure factor" of textile and machinery industries, more detailed analyses were conducted specifically, and some regional peculiarities of them were derived from them.

8) The coefficient of variation of value-added productivity among prefectures can be an indicator of regional differential, but that of employees, an indicator of regional concentration or dispersion. By computing them by industry, cross-classified by size of establishment, we get a consequence that the heavy industry rather than the light industry, and the higher size rather than the lower size of establishment, have higher indicators of regional differential as well as concentration.

MAP OF JAPAN


1. Hokkaidō
2. Aomori
3. Iwate
4. Miyagi
5. Akita
6. Yamagata
7. Fukushima
8. Ibaragi
9. Tochigi
10. Gunma
11. Saitama
12. Chiba
13. Tōkyō
14. Kanagawa
15. Niigata
16. Toyama
17. Ishikawa
18. Fukui
19. Yamanashi
20. Nagano
21. Gifu
22. Shizuoka
23. Aichi
24. Miye
25. Shiga
26. Kyōto
27. Ōsaka
28. Hyōgo
29. Nara
30. Wakayama
31. Tottori
32. Shimane
33. Okayama
34. Hiroshima
35. Yamaguchi
36. Tokushima
37. Kagawa
38. Ehime
39. Kōchi
40. Fukuoka
41. Saga
42. Nagasaki
43. Kumamoto
44. Ōita
45. Miyazaki
46. Kagoshima